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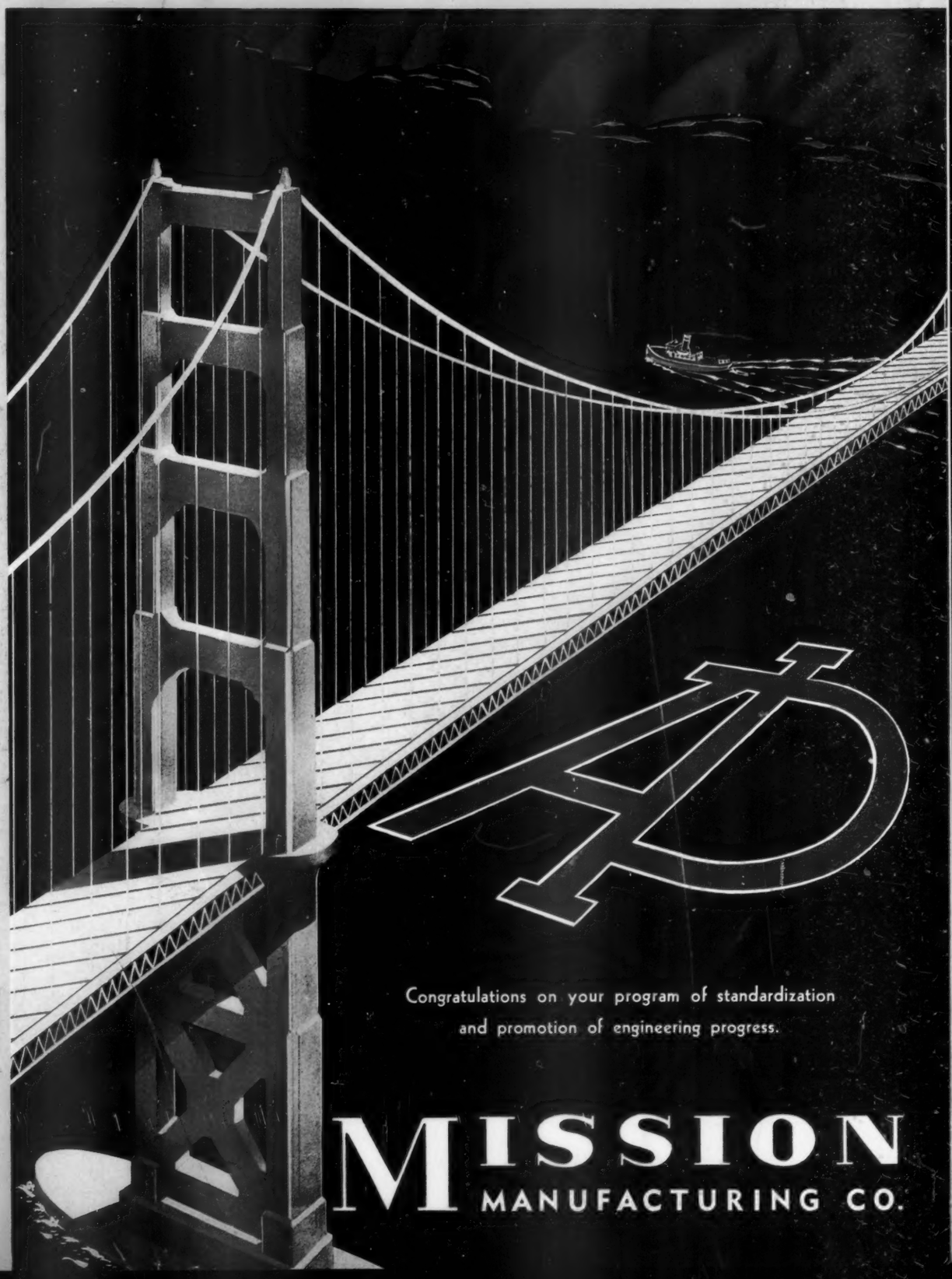

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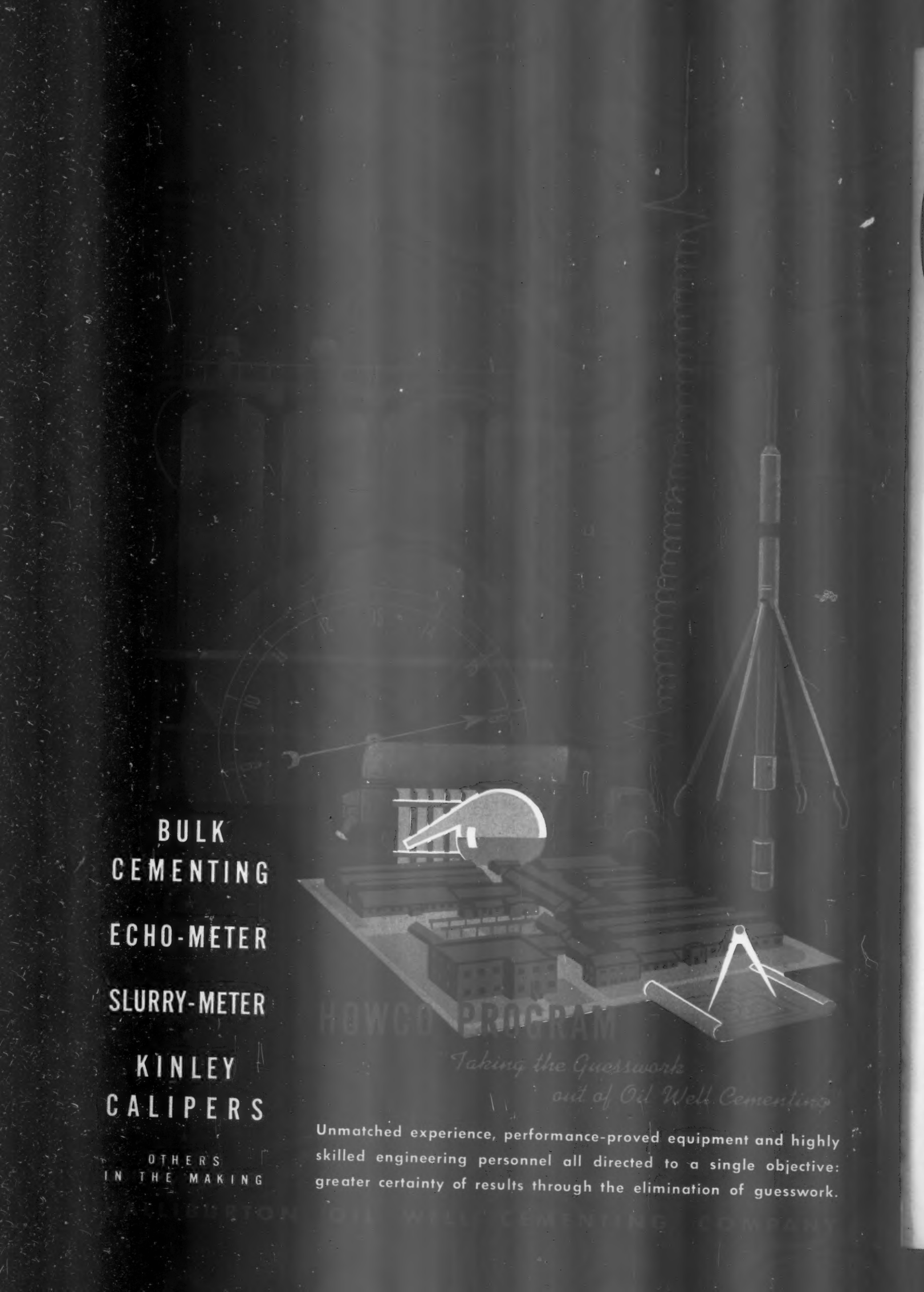
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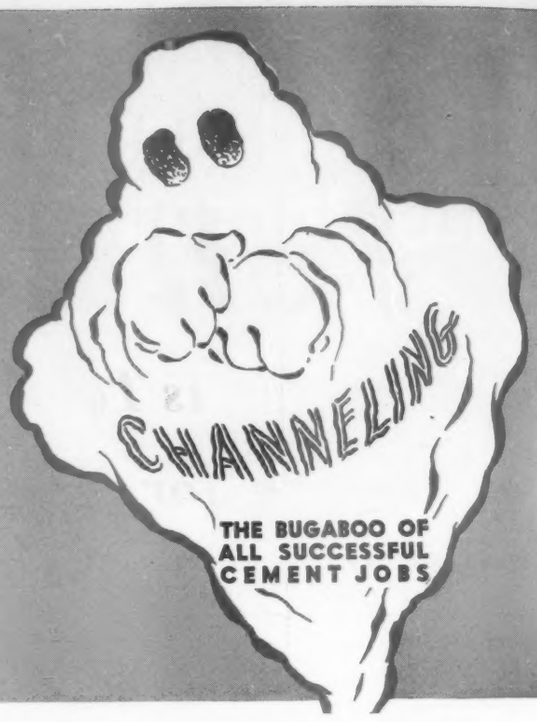
Reduce your CHANNELING WORRIES to about this size

. . . By Using BAKER WASH-DOWN WHIRLER EQUIPMENT



As experienced operators well know, one of the biggest bugaboos in cementing casing is the hazard of channeling . . . a factor which may necessitate a costly recement job. Experienced operators also know that Baker Cement Wash-Down Whirler Equipment reduces this costly hazard to a minimum by providing uniform distribution of cement at the critical point . . . the shoe and the shoe joint. (See illustration and accompanying details for reasons why.)

The efficiency of Baker Cement Wash-Down Whirler Equipment, which was introduced and developed by Baker engineers, has been demonstrated in thousands of successful cement jobs, and it is generally acknowledged today as being the most efficient type of cementing unit available.

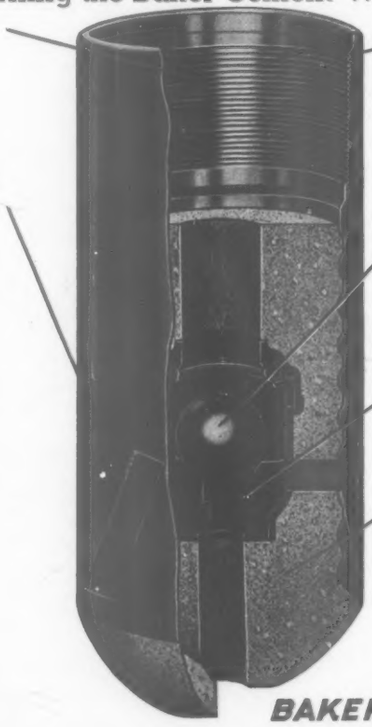
The Baker Whirler principle is available in two types of shoes . . . a Baker Cement Wash-Down Whirler Float Shoe and a Baker Cement Wash-Down Whirler Guide Shoe.

For detailed information, refer to Page 222 of the 1941 Composite Catalog, or get in touch with the nearest Baker office or field representative.

Here Are the Facts Concerning the Baker Cement Wash-Down Whirler Float Shoe:

1 THREADED CONNECTION FURNISHED TO FIT ANY TYPE OF CASING. Baker Floating Units can be furnished with threaded connection to fit the specifications of your casing. (Float collars can be furnished with both "female" and "male and female" threaded connections.) Manufacturing precision assures thread uniformity and accuracy.

5 BAFFLED WHIRLER PORTS. These whirler ports provide the important wash-down whirler action so advantageous in circulating and cementing operations. When the fluid strikes these baffled ports, a downward and then an upward whirling motion results. In running in, this whirling action provides a means of effectively washing away bridges. During cementing, the whirling action, imparted first to the fluid preceding the slurry and then to the slurry itself, properly prepares the hole to receive the cement. It then assures best possible distribution of a uniform body of cement around the shoe and the shoe joint, reducing the hazard of channeling to a minimum. Here is the ultimate in cementing efficiency.



2 AMPLE STRENGTH. The seamless steel casing shoe into which the concrete plug and Plastic BALL-TYPE Valve Assembly are securely anchored provides a unit that has the STRENGTH to float the longest and heaviest string of casing with an ample factor of SAFETY.

3 POSITIVE, LEAK-PROOF BACK-PRESSURE VALVE. The buoyant Plastic BALL-TYPE Back-Pressure Valve floats in the cement slurry or rotary mud and instantly forms a leak-proof double seal against a narrow, tough rubber ring (backed by Plastic and concrete) at the slightest reversal of pressure. Here is valve efficiency at its best.

4 AMPLE CIRCULATION AREAS. The correctly designed, streamlined Valve Assembly provides passageways ample for any circulating or cementing operation . . . a fact attested to by actual field performance under the most severe operating conditions.

6 DRILLABILITY. Complete and easy drillability results from the internal construction of Baker-Formula Concrete and Plastic . . . the Plastic BALL-TYPE Valve Assembly being set on end in the concrete plug to present a minimum cross-sectional area to the drilling bit. The concrete and the Plastic are quickly and easily drilled up and circulated out of the hole.

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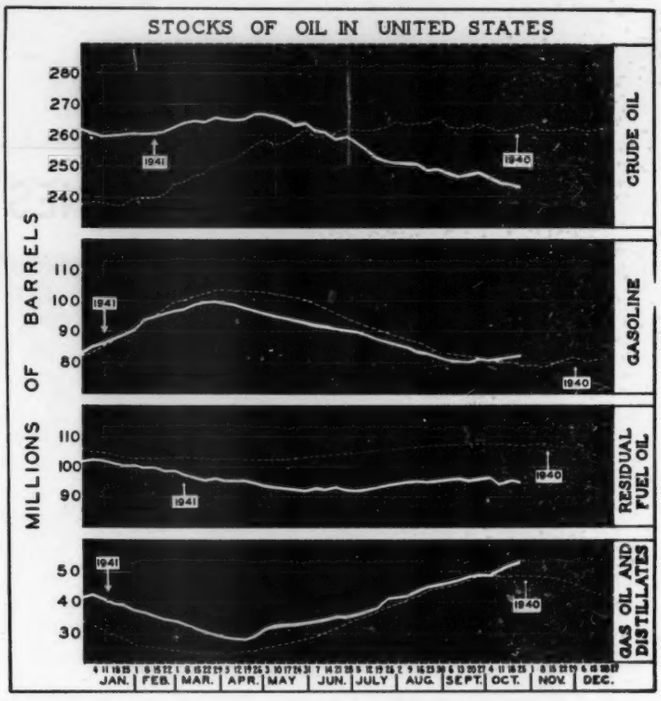
Trends

Industry Is Told to Prepare for Vastly Expanded Output



PREDICTION that the United States petroleum industry will be called upon to produce 5,000,000 bbl. of oil daily by the middle of 1943 made this week at San Francisco, Calif., is a highly significant one. Also significant was the urgency of Coordinator Ickes' 100-octane gasoline program calling for an increase of 45 per cent in productive capacity by the end of 1942.

CRUDE PRODUCTION *4,074,300 bbl. daily average—down 29,650 bbl. One year ago 3,643,955 bbl.*

CRUDE STOCKS *242,261,000 bbl. as of October 25—down 1,344,000 bbl. One year ago 262,746,000 bbl.*

GASOLINE STOCKS **83,343,000 bbl. as of October 25 — up 759,000 bbl. One year ago 79,800,000 bbl.*

RESIDUAL FUEL-OIL STOCKS *95,295,000 bbl. as of October 25 — down 485,000 bbl. One year ago 107,123,000 bbl.*

GAS OIL AND DISTILLATES *53,183,000 bbl. as of October 25—up 780,000 bbl. One year ago 48,990,000 bbl.*

REFINERY RUNS *4,060,000 bbl. daily week ended October 25 — down 60,000 bbl. One year ago 3,565,000 bbl.*

*Includes 7,130,000 bbl. aviation motor fuel, down 100,000 bbl. One year ago 6,171,000 bbl. Note: Later figures on refinery stocks unavailable owing to New York election day.

The figures are based on certain contingencies such as the loss of Russian fields and continuation of the European war. Too, the estimates were made by individuals not intimately connected with operations of the oil industry. Still, their viewpoints may have even greater significance because of their positions which enable them to overlook the details of operations and focus on broader aspects.

The goal of attaining capacity to manufacture 100,000 bbl. of 100-octane gasoline daily by the end of 1942 is the minimum, Coordinator Ickes declared, that the industry can safely sight upon. Anything short of that figure, he said, would be grounds for indictment of the industry in the court of public opinion.

Conviction that transportation snarls will be one of the chief barriers to prosecution of the oil industry's obligations during the emergency is still held by the coordinator. Reexpression of his belief at California indicates that his faith has not diminished in the desirability of constructing the national-defense line.

Shorn of all contingencies, the obligations of the oil industry as expressed by men of high position at the A.P.I. meeting, will require some of the most intensive work in the history of the petroleum business through the next 2 or 3 years. The chief concern of the industry over its ability to meet all the contingencies expressed or implied is in matter of obtaining material. Government and the petroleum industry have a common problem in arranging equipment with which to do the task that is taking more definite form with passage of time.

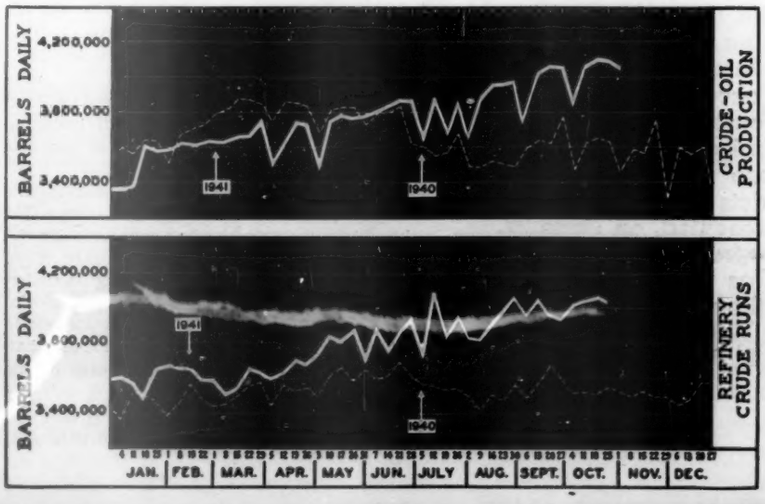
An official of OPM told oil men attending the A.P.I. meeting that a preference rating order for new equipment distribution to the oil industry has been tentatively approved extending a priority number of A-8. While it is too early to pass judgment, there is an immediate reaction the petroleum industry to the tasks assigned.

The industry has stepped up its production more than 425,000 bbl. per day from the rate of a year ago. This has required concentration of attention on the most readily available sources of production. The industry needs equipment with which to raise production on a curve terminating at 5,000,000 bbl. daily 1½ years from now.

DAILY AVERAGE PRODUCTION FOR WEEK

	Nov. 1, 1941	Bur. Mines Nov. est. of demand	November state allowables	Oct. 25, 1941
Arkansas	72,375	76,500	73,653	71,945
California	630,250	626,700	613,200	643,750
Eastern fields	114,250	114,800	.....	113,650
Illinois	418,975	408,100	.....	420,430
Kansas	237,350	253,500	257,000	255,500
Louisiana	342,150	333,200	347,058	344,695
North Louisiana	*80,750*	.....	.....	*81,295*
Louisiana Gulf Coast	*261,400*	.....	.....	*263,400*
Michigan	57,930	47,400	57,550	58,620
Mississippi	63,220	55,100	.....	66,400
Nebraska	7,250	6,200	.....	7,000
New Mexico	116,420	115,200	116,500	116,420
Oklahoma	436,500	469,400	428,000	425,450
Rocky Mountain states	107,680	109,200	.....	111,390
Texas	1,469,950	1,454,700	1,533,282	1,468,700
East Texas	*369,700*	.....	.....	*369,700*
West Texas	*285,600*	.....	.....	*283,700*
North Central Texas	*136,950*	.....	.....	*136,750*
East Central Texas	*85,850*	.....	.....	*85,700*
Texas Panhandle	*80,100*	.....	.....	*79,450*
Texas Gulf Coast	*416,400*	.....	.....	*417,500*
Southwest Texas	*95,350*	.....	.....	*95,900*
Total United States	4,074,300	4,070,000	.....	4,103,950

Total production, Jan. 1—Nov. 1, 1941.... 1,149,468,720 bbl.
Same period last year ..... 1,129,308,450 bbl.



PRIZE-WINNING ENTRIES IN SECOND PETROLEUM INDUSTRY

"MERIT"—First award. By C. P. Gravelle, Philadelphia, Pa.

"COTTON VALLEY"—Second award. By Robert Yarnall Richie, New York

Industry in Forefront of Nation's Defense Efforts, Oil Men Told

By C. O. WILLSON and L. P. STOCKMAN

These pages afford the reader a hasty summary of the highlights of the twenty-second annual meeting of the American Petroleum Institute at San Francisco. In accordance with the Journal's custom, several full-length technical papers are published, these starting on Page 81. Abstracts of other papers are also presented, on Page 77. Editorial representatives of The Oil and Gas Journal who are attending the sessions this week are C. O. Willson, L. P. Stockman and T. P. Sanders.

SAN FRANCISCO, Calif., Nov. 5.—More than 2,500 oil men who are here this week attending the twenty-second annual meeting of the American Petroleum Institute have had brought home to them as never before the fact that the oil industry has been moved to the front lines of the nation's civilian and military defenses. Representatives of the Government who came here as guest speakers at the general sessions and others who have participated in the group meetings have stressed the fact that this country's program of defense and aid to the Allies is based on the assumption that the oil industry can continue to furnish increasing supplies of the all-essential petroleum whenever and wherever it is needed.

It is agreed that the demand for domestic crude oils which now exceeds 4 million barrels daily will probably increase to at least 4½ million barrels next year. Pointing out that war developments indicate that the Soviet Union will shortly be cut off from a large part of its supplies, one speaker said it soon would be necessary for the United States to supply that nation with large quantities of oil if it is to continue fighting. He predicted that domestic demands and exports from this country would jump to 5 million barrels daily in 18 months.

It is apparent from the discussion here that the big question among oil operators is how to find new reserves and how to expand present plant facilities to efficiently refine more and more crude oil. The transportation of the crude oil and refinery products was also discussed, including plans for the wholesale distribution of products in the event of war.

It is agreed that practically all divisions of the industry's operations will have to be expanded quickly. At a meeting Monday sponsored by the equipment manufacturers, operators were given additional encouragement that Washington understands their problem and will make a special effort to aid the industry in getting materials to maintain present operations and to make whatever expansion is necessary to take care of the new requirements.

PHOTOGRAPHIC SALON, EXHIBITED AT A. P. I. MEETING

"LUBRICATION"—Third award. By Ennio H. Martinelli, San Francisco, Calif.

"WILD WELL"—Fourth award. By Jeff Davis, Little Rock, Ark.

Informal discussions around the lobbies and elsewhere were seeking the answer to the question as to where the next big oil fields will be found. It is felt that large new reserves each representing 100 million barrels or more of crude oil will have to be found in addition to numerous smaller discoveries and extensions in order that increases in reserves will keep pace with production next year and later.

Among refiners there is the feeling that the job of tripling the present production of 100-octane gasoline for aviation use as planned is much greater than was anticipated when the program was announced by the OPC a few weeks ago. It is also pointed out that many refiners will have to expand their present crude-topping and cracking facilities to keep pace with the greater requirements for motor fuels and other products.

As was expected, Petroleum Coordinator Ickes brought a message of cooperation between Government and the industry in his Wednesday address. At the same time he made clear his contention of the past that petroleum conservation could only be carried on successfully if all states and operators did their part. He warned that Illinois and California must adopt programs which are satisfactory to his office. Ralph K. Davies, petroleum coordinator, spoke at the general session Thursday and asked for cooperative effort between the industry and Government necessary to span the emergency.

W. R. Boyd, Jr., is slated to head the Institute's activities as president during the coming year. He was elected president last month to fill out the unexpired term of the late Axtell J. Byles, whose passing after many years of service to the industry left a void to hundreds in attendance at this meeting.

Mr. Boyd has been connected with the Institute from the year of its organization and has served as executive vice president in recent years. It is understood that the position of executive vice president will not be filled at this time.

Ickes Urges Oil Industry to Expand Defense Program

SAN FRANCISCO, Calif., Nov. 5.—Petroleum Coordinator Ickes reiterated his plea for increased production of aviation gasoline and pointed to the lack of conservation practices in Illinois and California as the surest way to throw control of the oil industry under a federal "czar" in his address at the general A.P.I. session today.

After reviewing functions of the petroleum coordinator since creation of the office, he launched into current issues and, in part, spoke as follows:

I shall continue to cooperate with you in what I believe to be reciprocal good will and patriotic endeavor on both sides. I believe that you are just as much interested as I am in seeing to it that the oil industry acquits itself with distinction in this emergency. You did a fine job 20 years ago in cooperation with the late Mark Requa, who was the wartime director of the Oil Division of the U. S. Fuel Administration. He had statutory powers which I do not possess. I hope that it will not be necessary for me to ask for them in order to carry out my responsibilities as petroleum coordinator. I would prefer to undertake all problems in the same cooperative spirit in which we found it possible to work when I was oil administrator in 1933. We have done the job together so far and there is no reason why we cannot continue to do it together.

I suspect that the tanker situation will be a troublesome one during the duration of this emergency. Besides this problem, the oil industry is already called upon to face others. All of us know that a grave inadequacy has been rapidly developing as to 100-octane aviation gasoline. In fact, some of you were in Washington on August 12 when I asked that immediate steps be taken to double our 100-octane manufacturing capacity. Later, when it became evident that even this

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PAUL D. TORREY
Sloan & Zook Co.,
Houston, Tex.

Presiding officers at group sessions held in connection with the annual meeting of the A.P.I. this week at San Francisco, Calif.

would not provide for already foreseeable demands, I set in motion processes to determine how we could not only double, but treble, our output.

A nation-wide survey, as of mid-October, demonstrated that our manufacturing capacity of 100-octane gasoline amounted to a total of 43,278 bbl. a day. Plants now nearing completion will add 2,557 bbl. daily by January 1, 1942. Additional arrangements have been made which will mean another 11,994 bbl. a day by January 1, 1943. Thus, we discover that 13 months from now our over-all production of 100-octane gasoline will be an inadequate 57,829 bbl. daily.

Needs Exceed Present Capacity

The country will not be satisfied with such a meager effort. A potential of 100,000 bbl. daily by January 1, 1943, will not come anywhere near supplying our own needs, in addition to those of Britain, Russia, and China. Fortunately, we can increase our 100-octane capacity to 100,000 bbl. daily by January 1, 1943, if the refiners are willing to do what our survey indicates ought to be possible. Capacity can be boosted during the next year by about 41,700 bbl. This would make a national output of approximately 100,000 bbl. daily by 1943. There is also the possibility of adding another 3,000 bbl. by the improvement of base stocks.

Even if we achieve this result we will still be 20,000 bbl. daily short of what the forecasts indicate that we shall need by 1943.

Your Government stands ready to assist in the financing of new refining facilities and equipment. Secretary Jones has said that he will be willing to enter into contracts on behalf of the Government for your future production of 100-octane gasoline covering a period of from 2 to 3 years.

Unfortunately, we are not even sure that we have sufficient capacity for producing all of the ordinary gasoline that we will need. Our refiners of motor fuel are now pretty close to 100 per cent capacity and the demand continues to rise.

If I now turn to the subject of possible federal control of the oil industry it is because I would not want any man here to think that I was dodging an issue that, to my knowledge, has been in the minds and on the lips of many. I am fully aware that, for reasons that I shall not take the time to analyze, or even the trouble to characterize, an effort has been made, ever since I was administrator of the oil code under NRA, to poison the minds of the people in the oil industry by charging that, if I could, I would take over and run your business. I hope that there are some among you who will agree that anyone who would deliberately set out to get control of the oil industry is the kind of a fellow who would want to be foster father to the "dead end kids."

REFINING NEEDS SUMMARIZED

A program that would increase capacity for producing 100-octane gasoline to 102,529 bbl. daily by the end of 1942 was outlined and acceptance urged on the petroleum industry by Secretary Ickes, the petroleum coordinator for national defense, in his A.P.I. address.

New plants would account for 41,700 bbl. of the daily capacity projected for construction in 1943 and improvement of base stocks will provide for 3,000 bbl. of the total.

Coordinator Ickes emphasized that the president's letter creating the office extended no power of control. He warned that continuation of practices such as exist in Illinois and California were the surest way of throwing the oil industry under federal control. He urged the industry to conduct its operations so efficiently that no improvement could be possible and in that way discourage outside interference.

In the forepart of his address, the coordinator summarized work of his office in coping with the transportation emergency, fostering pipe-line construction and sponsoring use of tank cars.

Denies Control Desires

So far as I know, the Government does not want to control the oil business. Here in California and elsewhere I have been characterized as "Oil Czar" Ickes or "Would-Be Oil Czar" Ickes. All of you know that the first characterization is not true, but if it serves the purpose of anyone to pretend that the second fits me he is welcome to his delusion. All of you also ought to know that my duties under the order issued by the president are merely those of a coordinator. I have neither the power nor the will to impose federal control upon the oil industry.

However, I do avow frankly, that I believe in the conservation of petroleum, as I believe in the conservation of all of our natural resources. And by "conservation" I do not mean withholding from use. What I mean is present prudent use, while preserving, for the welfare and happiness of our children, and theirs, all that we do not actually need for ourselves.

What I am leading up to is that if the federal Government ever imposes any measure of control over the oil industry, it will be in the interest of conservation. Wasteful practices, sooner or later, bring some type of federal control. And wasteful practices in the oil industry will also bring some measure of control—probably not during my tenure of public office—but yet surely and inevitably. The way—the only way—in which to make unnecessary such control as will prevent waste and intemperate exploitation will be for you to exercise that measure of self-control which will persuade the Government that you are managing your own affairs so competently, so wisely and so patriotically as to make unnecessary any interference by the people.

May I say, out of my friendly interest in the oil industry, and as a man who has come to know you and to appreciate you, better perhaps than I once did, that such practices as obtain in my own State of Illinois and in this State of California are better calculated to bring about at least some measure of federal control of the oil business than a thousand "would-be oil czars." You have the power to stop these practices; you have such power today. But you have not exercised it.

Assails "Criminal Waste"

Surely, you will admit the inconsistency of a company that employs conservative practices in one state while indulging in malpractices in another. I have protested vigorously the terrible, the criminal, waste that has gone on in the Illinois oil fields ever since the first well was put down. But greedy and corrupt politicians and facile-tongued wildcatters have produced such a state of mind among the farmers, on whose lands that oil has been found, as to convince them that the quickest way to wealth is recklessly to destroy wealth. I gladly concede that, generally speaking, there is far more observance of conservation practices in the oil industry than there was formerly. In this regard some companies are far ahead of others. But there is still too much waste, although this varies as between companies and localities. Considering the rate at which our petroleum resources are being exhausted, and considering also our reserves in comparison with those in other parts of the world, you will agree, I am sure, that no preventable waste of oil or gas ought longer to be permitted.

If I were a Californian, I could not rest until some curb had been put upon the tooth and claw practice which has characterized the oil and gas industry of this state since the beginning. Yet the exploiters of the state have twice brought about the defeat of conservation bills passed by the legislature—the Sharkey bill in 1932 and the Atkinson bill in 1939.

The way for you to avoid an oil "czar" is to eliminate wasteful practices as all of us know still exist in the oil business. It would be well to re-

member that the people endured patiently for a long time the unlimited taking of gas. Remember, too, that it was the transgressions of the railroads that resulted in the creation of the Interstate Commerce Commission. It was disregard by business of the right of the individual that brought about the antitrust laws. Such power is well on its way because of the oppressive practices of the private utilities. The Securities Exchance Act sprang from Wall Street itself.

Since public correction inexorably follows private excesses, although sometimes tardily, the point need not be labored that the only sure way for you to prevent ultimate governmental regulation or control of the oil business is voluntarily to remedy the excesses.

Cole Predicts Demand of Five Million Barrels Daily

SAN FRANCISCO, Calif., Nov. 5.—A prediction that domestic producers and refiners will soon be called upon to supply 5 million barrels of petroleum daily was made by Rep. W. P. Cole, Jr., of Maryland, who spoke at the first general session of the American Petroleum Institute annual meeting this afternoon. The congressman, who as chairman of a subcommittee, has conducted a congressional investigation of the petroleum industry's activities for more than 4 years, based his projection of future petroleum demands on the increased needs brought about by the defense program and the fact that war developments will mean enlarged shipments to the Allies.

After calling attention to present demands of more than 4 million barrels daily and the expectation that this total will increase to 4½ million barrels daily by next summer, Mr. Cole said, "If we become actively engaged in war where large bodies of our troops are engaged and with a very enlarged navy active, we may expect an additional consumption of at least 250,000 bbl. daily."

Mr. Cole, who has always indicated his opposition to federal control of the petroleum industry as a result of the investigations which his committee conducted, approved the objectives of the Office of Petroleum Coordinator. "Supervision during the emergency should be of a cooperative nature," Mr. Cole said. "These cooperative measures must not overcentralize power in the hands of either state or federal Government during the national-defense program but they must tend to balance the powers so that harmony will exist among all interests in all oil-producing states, and the people as a whole.

"You who believe in free enterprise regulated in the public interest or in what may be called humanized capitalism have to meet the challenge of making that system even better for the common weal. Any failure to meet the peak loads of those crowded days will be seized upon by the enemies of free enterprise as an excuse for the taking over and nationalizing of industry. The excuse may not be valid, but the loads imposed on industry by Government may be arbitrary and unpredictable. Congress is sympathetic with what you are called upon to do and is pleased to find the president taking time out from his day and night labors to comment favorably upon some aspects of your work.

"With the transportation of the Caucasus already severed by the Nazis it will be necessary to furnish Russia huge quantities of oil if it is to continue the war. Adding to the above, additional demands from Canada and Great Britain, a total demand of 5 million barrels daily within 18 months is not unlikely. It is obvious that such an enormous increase in demand would call for a vast development program." He pointed out that at this time the United States and the Allies control 96 per cent of the world's petroleum supplies.

"An ample supply of petroleum products is fully as important to our war effort as an ample supply of steel, ships, armament, explosives, or aircraft," Mr. Cole declared in a strong appeal that the industry be given adequate supplies.

"The federal Government must either make accessible to the industry the necessary pipe and other materials, or cut civilian consumption to meet the safe ability of the industry to produce."

The Maryland congressman was critical of the Allies in their failure to destroy the Rumanian oil fields and refineries which failure had made possible the Balkan and Russian campaign.

"Hitler cannot carry on an industrial economy for 300 million people and the same time conduct a long and vigorous war," Mr. Cole declared. "Central Europe used more than 400,000 bbl. daily during peace times. Certainly he cannot long continue a war on less than one-half that amount."

Pyron Admits Supply Needs But Urges Use Economy

SAN FRANCISCO, Calif., Nov. 6. — Assurance that federal agencies are aware of the vital role of the petroleum industry in the defense program and that they will cooperate in making materials available for petroleum's part in the emergency was given here today by Brig. Gen. Walter B. Pyron, who is vice president of Gulf Oil Corp., Houston, Tex., in civilian life. In the next breath, he called on those attending the second general session of the A.P.I. annual meeting to display the patriotism, ingenuity and the tenacity of purpose that has always characterized oil men and made them outstanding citizens in all past emergencies.

Products of the petroleum industry, Brigadier General Pyron pointed out, rank second only to the airplane, tank gun and battleship in national defense. After sketching the demands placed on general industry by the defense program, the speaker called on the oil men to project their operations on a basis that will enable it to fulfill all of its obligations in the emergency and still make a substantial contribution in the conservation of strategic materials.

"New wells must be drilled to assure the country of an adequate reserve," declared Brigadier General Pyron, "but this does not mean a drilling orgy but a well-planned and conservative program which will assure a supply of oil, even though the emergency last several years.

"There is the constant need for replacements and repairs to wells and all types of operating equipment, but greatest of all will be the need for steel, machinery and chemicals to materially increase the output of refineries. The agencies, in Washington—the OPM, SPAB, Petroleum Coordinator, the Army and Navy—are aware of the requirements of the industry and you may be as-

BRIG. GEN. WALTER B. PYRON
Vice president, Gulf Oil Corp., General session speaker

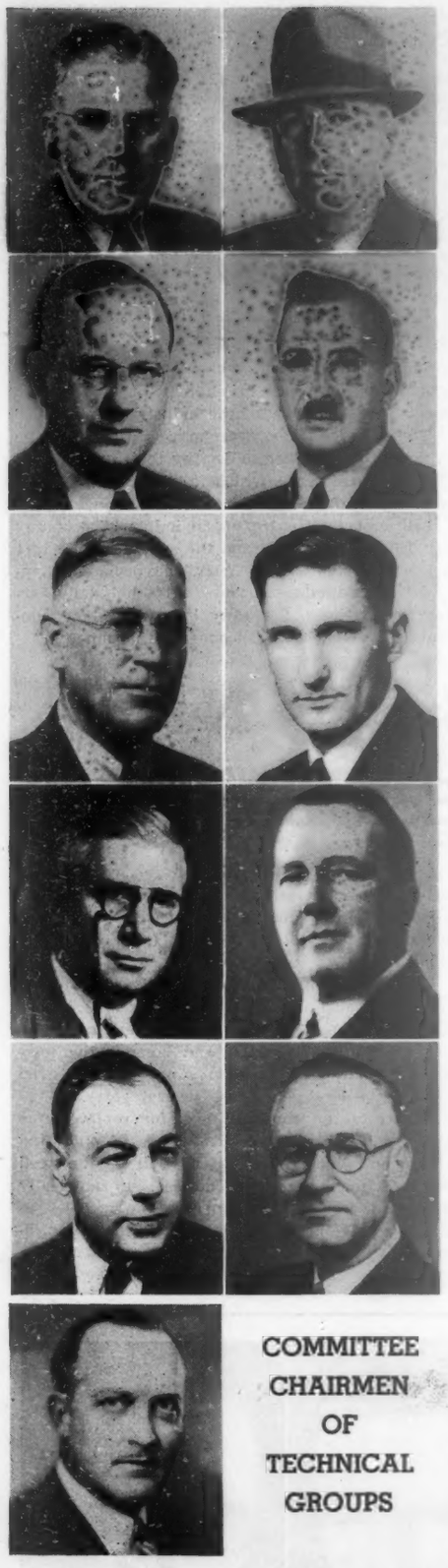
E. V. WEBER
Eureka Oil Co., Cincinnati, Ohio

G. G. OBERFELL
Phillips Petroleum Co. Bartlesville, Okla.

R. D. WYCKOFF
Gulf Research & Development Co., Pittsburgh, Pa.

S. J. DICKEY
General Petroleum Corp. Los Angeles, Calif.

The four men at the right presided at group sessions of various branches of the industry at the A.P.I. meeting in San Francisco



COMMITTEE CHAIRMEN OF TECHNICAL GROUPS

Left, top to bottom: Herbert W. Ladd, Stanolind Oil & Gas Co.; B. B. Cox, Socony-Vacuum Oil Co., Inc.; D. R. Dale, S. M. Jones Co.; J. B. Rather, Socony-Vacuum Oil Co., Inc.; A. B. Bagsar, Sun Oil Co., and F. S. Bryant, Standard Oil Co. of California. Right, top to bottom: R. W. Black, Standard Oil Co. of New Jersey; J. E. Toussaint, Standard Oil Co. of California; George H. Fancher, University of Texas; L. C. Welch, Standard Oil Co. (Indiana), and Basil Hopper, Union Oil Co. of California

sured of their cooperation and helpfulness in meeting these problems. But industry must play the game fairly and make such changes and sacrifices as may be found necessary in carrying out the whole defense plan of the nation. Industry must lay aside all selfishness and desire to capitalize on the emergency, to gain a favored position or to demand, for example, critical materials when some less essential material could be used. If, for example, the industry demands nickel steel or other products of that nature, you deprive the Army and Navy of just that much material which must be used in manufacture of tanks, guns, etc., which cannot be made of substitute materials."

Watch Stocks Closely

One means of aiding the defense program outlined by the combination Army officer-oil executive is for the oil industry to prolong the service life of equipment. "The oil industry," he said, "will make a distinct contribution to the defense plan if they watch warehouse stocks closely and keep them to a minimum; if they will see to it that no idle material is stored in field or in refinery yards; in other words, put all surplus materials to work producing more oil, moving more oil or refining more oil. That is sound business practice, normally, but in this emergency it is not only good business, but will mean the speedup of the entire defense program.

"Under the present situation," he declared earlier, "you can speed up the general defense program by delaying the replacement of machinery and materials, beyond the point of what you consider, normally, good operating procedure. As an example, if you move one 136-ft. derrick to a new location, instead of buying a new one, you release enough steel to manufacture one medium tank. By using 250 ft. of No. 4 rotary chain a little longer, you release enough steel to make the essential parts of 100 Garand rifles. If you can continue the use of just 1,000 ft. of ⅞-in. sucker rods you release enough steel to make 24 60-mm. mortars and if your pipe-line department orders 250 ft. of 16-in. pipe it is taking out of service enough steel to make one 155-mm. howitzer and if your production man buys 1,000 ft. of new 7-in. 20-lb. casing he is using the equivalent, in steel, of ten 37-mm. antitank guns. I am giving you these illustrations so that you may understand how vital it is for the industry to conserve their materials and machinery to the fullest extent in order that our Government may speedily carry out its armament program.

"The refining branch of the industry will no doubt be called upon to very materially and quickly expand its facilities for the manufacture of high-octane gasoline and high-quality lubricating oil. If the refiners meet this challenge and refine, in required quantities, a gasoline that will, for example, propel an airplane 10 to 20 miles per hour faster and climb 25 per cent faster they will have contributed greatly to the defense plan and will result finally in bringing to a speedy end the terrible carnage that is going on in the world today. The refining branch of the industry, with its outstanding chemists and engineers, I am confident, will meet this challenge promptly and efficiently."

Galbraith Appeals for Support In British War Effort

A BITTER denunciation of Germany and a strong appeal for support of every industrial plant in the United States in the fight against the Nazi Reich were placed before the general session Thursday by Comdr. T. G. Galbraith, R. N., M.P., a member of the British Supply Council, Washington, D. C.

Gratitude for the aid America has extended the British was expressed along with a plea for even greater cooperation in what the speaker said was a common problem of controlling or dismembering Germany.

"There is a challenge to American industry such as it has never before been asked to face," declared Commander Galbraith, "a challenge which to meet successfully will call for all the skill, all the efficiency, and all the energy of her great industries, a challenge to her supremacy as the greatest producing country in the world, a challenge to her pride in past achievements but a challenge which we in Britain see her meet triumphant, believing that the output and the excellency of the output of free men far exceeds that of men in countries where the state has usurped the place of God and they are but slaves and puppets. . . .

"History records no comparable example of the individual citizens of one country giving so lavishly, so unselfishly to another nation in its time of peril. And here let me say a special word of thanks to you as representatives of your great industry. Without the whole-hearted backing of the petroleum industry of America we could not long continue. We feel that we have had that backing from the very outset, that you have strained every effort to supply our need, that you have stood and will continue to stand behind us 'til we have finished the job, 'til victory is won, 'til democracy is made secure."

Commander Galbraith declared that a compromise peace is impossible and pledged that the British Navy would never be relegated to the position of the French. He said that industrial capacity of Germany and the countries under her control exceed by many times that of Britain and that America is the only country that can fill this gap.

Haake Points Out Alternatives America Must Choose Between

IN a stirring address entitled "A Call to Arms for American Well Being," Alfred P. Haake, managing director, National Association of Furniture Manufacturers, of Chicago, declared that today we face a solemn choice. He said we must choose between "government domination of all enterprise leading inevitably to the slow strangulation of individual resourcefulness and thus to a static economy, or the preservation of our free-enterprise system through vigorous self-discipline and wise regulation."

Dr. Haake denied that wealth or income can be divided equally. To attempt equal distribution would mean that all incomes would be leveled down to sheer poverty. The moment progress begins, he said, inequality begins with it.

"Unless the significant facts of industry, finance, and trade are put before and understood by the people," Dr. Haake averred, "the people cannot govern themselves; and as life in all its

phases becomes more complex, such failure leads inevitably to dictatorship."

Continuing, he said that he proposes "active and fearless espousal of the greatest force in mankind: the urge to improve and acquire, on the basis of individual ownership and enjoyment, with fair rules to control the competition of free individuals, namely, competitive enterprise, democracy in economic action, to bring about the realization of man's greatest dream, the greatest good for the greatest number. As crusaders, business men should take the offensive in a new and sound movement to save America from the poisons that are destroying Europe and to build for our people a sound security based on character and worth, with a constantly better functioning of our economic order of private and competitive enterprise."

Boyd Pledges Support of Industry to Defense

By W. R. BOYD, JR.
American Petroleum Institute, New York

The president's annual address, a slightly abbreviated version of which is published herewith, was prefaced with a eulogy to Axtell J. Byles, former president of the Institute, who died September 28. Mr. Byles was accorded high praise for his devoted service to promotion of the best interests of the industry he served and to the Institute.

"When death comes," asked Mr. Boyd in closing the eulogy, "what nobler epitaph can any man have than this: that, having served his generation, by the will of God, he fell asleep?"

IN preparation for my remarks today, I was tempted to assemble material and tell about the record of accomplishment of the Institute. Having been, for more than 21 years, a participant in the activities which resulted in making this record, you will understand my pride in all the Institute's achievements.

But the theme of my remarks today, as you shall hear, relates to other matters than Institute work.

Appearing about a fortnight ago before a Senate committee, Secretary of the Interior Ickes, who is also petroleum coordinator for national defense, was quoted as saying:

"During the next weeks and months the American people will be called upon to exercise some pretty sober judgments. They are engaged in a critical effort to forestall any attempt to destroy their rights as free men and women. Nothing—and I make not a single exception—is more important to this effort than is petroleum."

I can think of nobody in government authority who has had better opportunity in recent years to arrive at a correct appraisal of petroleum's importance; so I have particular pleasure in quoting from him a judgment in which I am sure everybody here can agree.

Pledges Utmost Support

Representing an industry to which so distinguished an authority as Secretary Ickes pays so distinguished a tribute, I feel that this twenty-second annual meeting of the American Petroleum Institute should be occasion for pledging the utmost measure of support and cooperation which appropriately and lawfully can be given in every effort of our Government to insure the national defense. I know how earnestly Secretary Ickes hopes for that cooperation. In one of his conferences with oil-industry executives I am told that he assured them that he had no intention of changing the competitive relationships among units of the industry during the emergency period. He is reported to have said he wanted so to conduct his coordinating work that when this was over the industry and he might "kiss each other goodbye with the best of feeling," and the industry would be able to say at least that, "with all we have been called upon to do, we have not been permanently affected as regards our competitive relationships."

I know that such support and cooperation as the secretary desires is also the fixed purpose in the minds of all of us. And for its effect on the national morale, I feel that that purpose should be proclaimed from this gathering in terms that can nowhere be misunderstood or misinterpreted.

Our country, while yet at peace, and hoping to remain at peace, has solemnly undertaken to extend all possible assistance to the nations that are so gallantly fighting to save the world from despotism and totalitarianism. It is our hope that thus we may be able to make our greatest contribution towards the victory of the democratic cause. In a war whose weapons are machines and the products of machines, our country's weight cannot fail to turn the scales to the side on which that weight is cast. Here the possibilities of machinery, of mechanical power, of mass production, have seen their highest development—both quantitatively and qualitatively. Our hope to avoid further involvement in the war sees its best chance of realization through the utmost utilization of those possibilities.

A quarter century ago we faced a situation in many ways similar to that of today. We had entered on a path that ultimately led us into the conflict of arms. The scenery along the route

A.P.I. AUTHORS

Among the A.P.I. authors were: Left, top to bottom, Albert Edison Miller, Sinclair Refining Co.; A. W. Bartok, Jones & Laughlin Steel Corp.; R. Floyd Farris, Stanolind Oil & Gas Co.; J. N. Cosby, Pennsylvania State College; Oliver Johnson, Standard Oil Co. of California; J. M. Pearson, Susquehanna Pipe Line Co., and T. H. Risk, Ethyl Gasoline Corp. Right, top to bottom, William B. Chenault, Sinclair Refining Co.; P. D. Thomas, Jones & Laughlin Steel Corp.; H. G. Texter, Spang Chalfant, Inc.; M. B. Standing, Standard Oil Co. of California; M. B. Anfenger, Standard Oil Co. of California; Frederick C. Horner, General Motors Corp., and E. M. Fitz, Shell Oil Co., Inc.

we are now traveling is strikingly similar; yet I have faith to hope that, if we do the full part we have undertaken, this route may lead us to a different destination. To that end, let me repeat, we must have complete unanimity of purpose, of effort, and of sacrifice, and have it now. Our industry of petroleum has been called on for its full share in the effort and in the sacrifice. Secretary Ickes has told us how important, in this effort, he rates our industry of petroleum and its products. To what he has so well said, I would add a reminder of how helpful, how inspiring to the national morale, we can make our industry by giving an example of united purpose and unstinted effort. Without governmental pressure, or any other outside influence, we achieved that unity in the crisis of a quarter century ago. That experience may well be a lamp to our feet in finding a way we are called to follow now. Therefore, I have thought it worthwhile briefly to recall how our industry mobilized its resources and its energies in support of the democracies and defense of our country at the time of the last war.

During the World War I period, the men who conducted the operations of the highly competitive units engaged in the petroleum business, under adequate and appropriate governmental supervision, engaged in full, frank, free, and fair discussion of every problem that arose, and later solved these problems. There was no coercion, no employment of force, save only the coercion of patriotism and the force of sound well-considered judgment. And parenthetically, something else is well worth mentioning here, namely, that out of this war experience the American Petroleum Institute was born, sired by the members of the National Petroleum War Service Committee who composed the membership of the first Institute board of directors.

We cannot build pipe lines to the future. None of us knows just what the political, economic, or industrial order will be when we emerge from the conflict. This is something in which all engaged in our industry should be interested. The political, social, and economic aftermath of the war is tremendously important to all of you.

When this cruel war is over, we are going to hear a lot about "reconstruction." All manner of schemes—some sensible, some fantastic—will be proposed and discussed. Many types of mentality will have panaceas. The word "reconstruction" will become the shibboleth for the establishment of schemes for the new and perfect social order.

Those of you who have devoted your business lives and energies to the petroleum industry recognize that its spectacular development has been due to the independence, individuality, and initiative that have always characterized its activities. One of the greatest American industries, and predominant among petroleum operations of the world, it is an outstanding product of the American system of free enterprise. It has won its way to world leadership in competition with the international cartels and government-controlled monopolies of the Old World, because, here, we have been free from the interferences, the intrusions, the restrictions, the paralyzing controls, that other governments have persistently imposed.

Petroleum has been a prize of international intrigue, a temptation to territorial adventure, a justification for conflict in arms. On the other hand, the United States has allowed full opportunity for petroleum's development by the men of business vision, investors, experimenters, technologists, and scientists. Because such men have thus been free, because opportunity has been open to all, our petroleum industry has become a tower of strength in the national defense and a testimony to the soundness of democratic processes.

Of course, the petroleum industry has not been alone in benefiting by our American system of competitive enterprise. Other great industries have grown and prospered for exactly the same reason. Our country is foremost in wealth, in productiveness, in generous standards of living, because here men have been free to make the most of themselves, to given rein to their utmost ambitions, imaginations, talents, and energies. You and I chance to be most familiar with accomplishments in the petroleum industry, but we know that the same conditions have made for the same kind of development throughout the entire field of American enterprise.

Preservation of American System

Because we so fully recognize this, it is my belief that we should at all times uphold all measures which aim at understanding and preserving our historic democracy and the fundamental guarantees of our American economic system. In fact, it would seem to me to be our solemn duty; for, as we survey a warring world, we see that everywhere the philosophy of totalitarianism is seeking to uproot, destroy, and supplant whatever measure of freedom men have attained. Autocracy is in arms, determined to impose its rule upon every people. We are committed to support those who are fighting it; and in that commitment we shall not fail or falter, however much it means in hardships and sacrifices.

We must not forget, when we submit to these hard disciplines, that the things we would preserve are themselves menaced by the very measures we must take to defend them. We shall be called upon to give up many of the satisfactions, to curtail many of the privileges, which have become part of our normal, democratic, American way of living. Business here in America during the war period will be done under restrictions and controls which in other circumstances would be intolerable. For defense purposes we shall be guided, directed, regulated. Influences will be at work all over the world to turn our political and economic organization toward socialization, or totalitarianism, or whatever you choose to call it; hence, we owe it to ourselves and to our industry and to our nation constantly to be on our guard to insure that, in helping to win a military victory, we do not ourselves suffer a spiritual defeat. To crush the military forces of totalitarianism on the other side of the ocean, at the cost of entrenching its political and economic program here in America, would be a tragic end to a noble national effort.

In this moment of emergency we are duty-bound—and it is our desire, each and every one of us—to give every cooperation to our Government. Indeed, just to the extent that we shall make our cooperation effective during the period of emergency we shall prove our title to independence and freedom after the emergency shall have passed. The task of preparation for the national defense will demand the exercise of all the imagination, ingenuity, inventiveness, and enterprise of which the whole nation is capable. New ideas, new devices, processes, and products are in demand. As we meet that demand now, new possibilities will be developed that will open new markets, new opportunities for expansion, after the emergency has passed. It would be my hope that, in relation to whatever plans are made for expansion of our industry's facilities, the industry's own money will be forthcoming and ample to finance all requirements and all obligations.

All experience proves that the kind of tasks we now face can be discharged only by exercise of the same talents that are developed in the operations of independent, competitive enterprise. As I already have pointed out, in World War I the American petroleum industry, called to perform gigantic tasks, was given the widest possible privilege of self-control; and it did its job in a way that won universal approbation. In the discharge of our present obligation, we must be determined to deserve an equally generous verdict; and thus far, at least, the record suffers nothing by comparison. It is no wonder that, when 20 per cent of our tanker fleet was taken from us this year, there was grave concern in the industry, in government circles, and among consumers, about getting petroleum products delivered where they would be needed. Yet, with the prompt cooperation of the industry, and of the governmental authorities and the various transportation agencies, operations speedily were tightened up, new facilities provided, new routes opened, and old ones used more effectively. Everyone in authority cooperated, and those who knew the job were given a free hand to do it. Emergencies furnish new incentives to get out of our resources more than we ever deemed possible; necessity brings new methods.

I have summarized a few of the achievements of the petroleum industry under our American free-enterprise system, because I think they are fairly typical of the workings of that system throughout all departments of productive activity. American standards of living are the world's highest, and they continue to rise at a rate unmatched in any previous epoch of history. Other nations, other peoples, other continents, possess natural resources quite comparable with our own. They have developed under civilizations far older than ours. We can hardly assume that, as a people, we are their superiors in intellectual gifts; for are we not the composite of all of them? Yet we seem to be recognized everywhere as the world's favored children of fortune. Why? There seems to me to be but one explanation, namely, our institutions of democrary, and our system of equality of opportunity and freedom to engage in competitive enterprise! So, while performing our duties of today, we must think of tomorrow! If our government should impose on the oil industry controls which would destroy the initiative, incentive, opportunity, and enterprise which can develop only when the spirit of competition is present, there would be sacrificed many times as much as could possibly be gained through the operation of such controls.

Plea for Industry

I am confident that, whatever demands may be made upon the oil industry or, in fact, upon the entire productive establishment of the nation, they will be met. Our industry asks only to be permitted cooperatively and understandingly to work out its own methods; that it be subjected to no suspicions as to its patriotism; and that it be given no reason to fear that honest, friendly cooperation with our Government today may open the way to totalitarian domination or control tomorrow.

The oil industry's whole history has been a record of surmounting obstacles, of accomplishing the impossible, and of dealing with crises. In oil, we have been trained to expect always the unexpected. Whether in the production of crude oil, the diversification of its products, the improvement of their quality, or in meeting requirements for ever-increasing quantities of them, our industry's record stands without parallel in industrial history. Year by year, petroleum products have gone to the consumer at progressively reduced costs. In quarters where critisism was readiest and sharpest, it has won acclaim as a model employer of labor. While the statistics of commodity prices show that those in the petroleum group are the cheapest, the statistics of wages show that, in petroleum refining average pay per

TYPICAL OF MANY TRANSPORTATION CENTERS THIS WEEK WAS THE SCENE AT CHICAGO, ILL., SHOWING A LINE OF PASSENGERS PREPARING TO BOARD ONE OF THE JOURNAL'S SPECIALS TO THE A.P.I. ANNUAL MEETING IN SAN FRANCISCO, CALIF.

This Week...

Coordinator Ickes urged the industry to follow through on a program that would increase capacity for producing 100-octane gasoline to 102,529 bbl. daily by the end of 1942. Nearly 45 per cent of the program requires new plants.

●

OPA is contemplating a price ceiling on used steel drums. Prices have risen to double the normal market for new drums. OPC recommends discontinuance of the use of metal containers for packaging oil products.

●

Rains and floods over wide sections of the oil country interfered with normal operations. Well completions fell to 657 for the week.

●

December production allowables in Texas to receive discussion November 17.

●

Stocks of petroleum in Germany were estimated sufficient to last another 5 months at the present rate of consumption.

●

Contractors and operators were asked for briefs to support their opposition to the Internal Revenue Bureau's proposal to ban deduction of drilling expenses from income tax accounts. This was the result of a conference at Washington.

●

Demand for 5 million barrels of oil daily from the United States by the middle of 1943 was predicted at San Francisco, Calif., by Rep. William P. Cole, Jr.

●

Three more American tankers returned to domestic service, making a total of 15 relinquished by the British—25 more due back this month. Atlantic Refining Co. announced the John D. Gill, another new tanker, will be launched November 15 at Sun Shipbuilding & Dry Dock Co. yards.

●

A priority rating of A-8 in the tentative preference rating order for new equipment needs of the industry now receiving consideration by OPM.

●

Rail movement of petroleum products to the East Coast has practically ceased since Britain announced return of 40 tankers. Peak tank-car movement during emergency totaled 1,000,000 bbl. a week.

●

Tankers are calling for Gulf Coast cargoes ahead of schedule. Refiners struggle to fill cargoes earlier than specified in sales contracts. Markets withstand freer-transportation factor without difficulty.

●

District 5's production committee and OPC are now working toward December 1 as the starting date for the new Pacific Coast conservation plan. OPC hints that a program along lines of the Arkansas statute would be most acceptable.

●

A.F.L. has announced establishment of an organizing office on the Gulf Coast in competition with I.O.W.U., affiliate of C.I.O. Factional disputes are starting through newspapers.

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hour is one of the highest in any manufacturing industry. To put these statistics in terms of the buying power of wages, we may say that over a quarter of a century the price of gasoline—exclusive of the ubiquitous, excessive gasoline taxes—dropped just about one-half, but the average wages paid by a typical oil company, over that same period, increased just about four times! The buying power of the worker's wages, in terms of the commodity he was producing, had multiplied by eight!

The president has designated Secretary Ickes as petroleum coordinator for national defense; and from the ranks of our industry, our friend, Ralph Davies, has been named deputy coordinator. Our industry should fit itself into the proper national scheme of organization in order to conduct effectively oil activities for national-defense purposes. We shall quickly adjust ourselves to the unified demand of war, but the building of the most effective oil organization for defense purposes cannot be done overnight; it must come through trial-and-error processes.

Only a few days ago I read the comment of a writer who was discussing the general picture of present-day war-preparation activity. In substance he said that in 1917 there was suddenly brought together in Washington the largest collection of aggressive personalities the world had ever seen, with the most patriotic motives, seeking no personal reward and unmoved by vanity or greed—all contributing their level best to our Government's avowed task of making the world safe for democracy. He commented that, if anyone had told them that they were doing anything to trample on any rights of their fellowmen, they would have been bewildered and indignant, because they merely wished to do the right thing according to their lights. But, he said, in the haste to get things done there never had been more chaos of conflicting plans, schemes, and authority than was evident in the preliminary stages of the last war.

Armies, military or industrial, to win victories, must be well organized; but all of us know that effective organizations are built slowly—and I would offer a word of caution to all to be patient and tolerant, and careful about criticizing too severely during these formative stages.

The American Petroleum Institute has no official place set aside for it in the program of organization thus far developed by the petroleum coordinator for national defense. With or without any official standing, the Institute will in future, as in the past, whenever its aid is requested, make available to the coordinator, to the deputy coordinator, and their staff, every instrumentality and all the data we posses. It has been my consistent recommendation and urge to all engaged in the industry to give every type of cooperation that is essential to the national defense, by the most apt means and expeditious routes that can be devised. And the same cooperative attitude should be taken towards all other agencies of the Government that are clothed with authority and charged with responsibility in preparation for the national defense.

In conclusion, let me repeat, that the better we cooperate and serve now, the prouder we shall be of the job done; the more we shall be entitled to be released from governmental controls, hampering restrictions, and every interference with the right of free enterprise to render its full service to the public weal. Thus shall we make our supreme contribution toward preserving and perpetuating our great fundamental rights of representative political democracy, civil and religious liberty, and economic freedom.

●

Octane Race Over for Emergency, Frey Declares

SAN FRANCISCO, Calif., Nov. 6.—The gasoline octane race is over for the duration of this emergency, Dr. John M. Frey, OPC's director of marketing, predicted at the A.P.I.'s Marketing Division meeting here today. Dr. Frey reviewed the present gasoline situation and outlook, pointing out that the greatly increased military demands for 100-octane fuel and the enlarged needs of the land forces for quality fuels will reduce the supplies of high-octane blending material available to civilians. The tetraethyl lead situation is also a factor in this development, Dr. Frey said.

Due to the demands for butane in the manufacture of the high-octane fuels, it may be necessary to restrict its use in liquefied gases, Dr. Frey explained in his talk in which he discussed several probable changes in marketing practices during the emergency. He said that the marketing branch needed a better priority position to assure the maintenance of its present marketing facilities and services.

Geologic Introduction Opens Fall Meeting of A.I.M.E.

By T. P. SANDERS

LOS ANGELES, Calif.—Introductory address for the fall meeting of the American Institute of Mining and Metallurgical Engineers, Petroleum Division, held here October 29 and 30, was an unwritten paper of very broad interest presented by H. W. Hoots, chief geologist of Richfield Oil Corp. under the title "Geologic Setting for Occurrence of Oil in California." Pointing out that geologists were charged with the duty of discovering new reserves at a rate comparable with oil-market demand, Mr. Hoots mentioned that the greatest assets that the public and the defense program could cite as assurances of fulfillment of this duty were the 3,500 geologists actively competing against one another and the willingness of oil concerns to explore upon the basis of geological advice.

California, ranking second in the nation from the standpoint of both production and reserves, has 59 per cent of the areal extent of the title-holder, Texas, with 55 per cent as much oil, including both the past production and the reserves. From these figures it appears that both states were almost equally gifted in relation to their areal extent. However, the similarity no longer exists when prospective area is considered. Seventy-five per cent of the area of Texas is prospective, while only 35 per cent of California offers prospective possibilities.

Three and one-half per cent of California's area has proved to be productive to date. One-half of the known reserves are located in the southern portion of the San Joaquin Valley, and this same area still offers the best chance for new discoveries. All important accumulations so far discovered in the central sector of the valley have been restricted to closed anticlines, and this suggests the presence of accumulations in structural traps of other types.

With cross-sections through the San Joaquin Valley, Mr. Hoots showed that shaping of the valley began at the close of the Miocene when the Temblor range was slowly uplifted to arch the sediments that have been deposited from the Sierras that form the eastern limits of the valley. Thus the Miocene and older beds show a regional thickening to the west throughout the valley, while the Pliocene and Pleistocene sediments, which were deposited in the valley much as it is shaped today, show great thickness on the valley floor with lensing at both extremities.

Suggesting that much of California's future oil would of necessity come from structural traps formed by lensing updip, faulting, or gradation of sand to shale, Mr. Hoots mentioned that since early days of the petroleum industry California had had an excellent example of this type of trap in the Midway-Sunset field, but geologists had tended to minimize its importance until after discovery of the East Texas field, and after A. I. Levorsen had called attention to methods of prospecting for accumulations of this type in his presidential address before the A.A.P.G. Discovery of the East Coalinga field was cited as an example of one method of finding traps of this kind. The Gatchell sand had been found in well logs, but it was missing in the surface section. Drilling found the sand near its updip extremity, thereby opening the field.

Surface field geology, according to Mr. Hoots, reached its peak in 1925, but is still extremely important. The Newhall-Potrero, the Del Valle, and the new unnamed field of that area were all discovered within the past 4 years solely as the result of surface study. Added to surface field study, the geologist has acquired important new tools, one of the most significant of which is the electric log. Another tool, the seismograph, has brought about the discovery of half a billion barrels of oil in the Southern San Joaquin Valley since 1934. Mr. Hoots showed a comparison between a subsurface contour map made entirely by seismograph work and the subsequent contours made from well logs. Differences were hardly noticeable without close study.

Mr. Hoots justified studies of the origin and movement of oil and natural gas, saying he believed geology will become a more efficient science when indisputable explanations have been found for such phenomena as isolated accumula-

(Continued on Page 72)

Two of the papers presented at the A.I.M.E. meeting in Los Angeles are abstracted in this issue, on Page 166.

Right: C. P. Watson, incoming chairman of the southern California section of A.I.M.E., who will be in charge of arrangements for the regional meeting next summer; Eugene A. Stephenson, chairman of the Petroleum Division; L. E. Porter, who arranged the program of the meeting, and Harry Stolz, who will take office in February as general chairman of the petroleum section. Mr. Stolz is a partner in the firm of Stanley and Stolz, engineering and geological consultants, but has been called to active duty as a lieutenant commander in the Office of the Inspector of Naval Petroleum Reserves for California

Left: E. K. Parks, chairman of one of the technical sessions and private consultant of Los Angeles; Chester Naramore, assistant secretary of the A.I.M.E. New York staff; W. S. (Buck) Morris, chairman of papers and programs committee; Howard Pyle, chairman of one of the sessions and chief production engineer for Union Oil Co.; and E. J. Kennedy, Jr., assistant to the secretary of A.I.M.E.

Luck like this Seldom Happens

Special to The Star-Telegram
[redacted] is having trou-
ble pumping mud in the hole due
to the well flowing mud and oil
after knocking out bridge that had
formed below the casing that had
been left in the hole following the
abandonment of this test several
months ago. Abandoned as dry, be-
low 6,000 feet, the well recently has
been showing considerable oil and
gas from around top of casing that
had been left and the operators are
back in the hole making an effort
to determine the exact source of
the oil showings.

LADY LUCK was on a determined hunt for this operator and found him. Only once in a very blue moon does "Farmer's oil" ever reach the top of the ground; but if the truth were known, more good oil wells have been passed up than oil men will admit to themselves. Passed up, because no core was taken. In this day of rotary tools and high-pressure pumps a porous and permeable sand or lime doesn't have a Chinaman's chance to do more than make a faint rainbow in the pit. Too faint to look interesting. Chances are that is exactly what happened here.

Read the clipping above.

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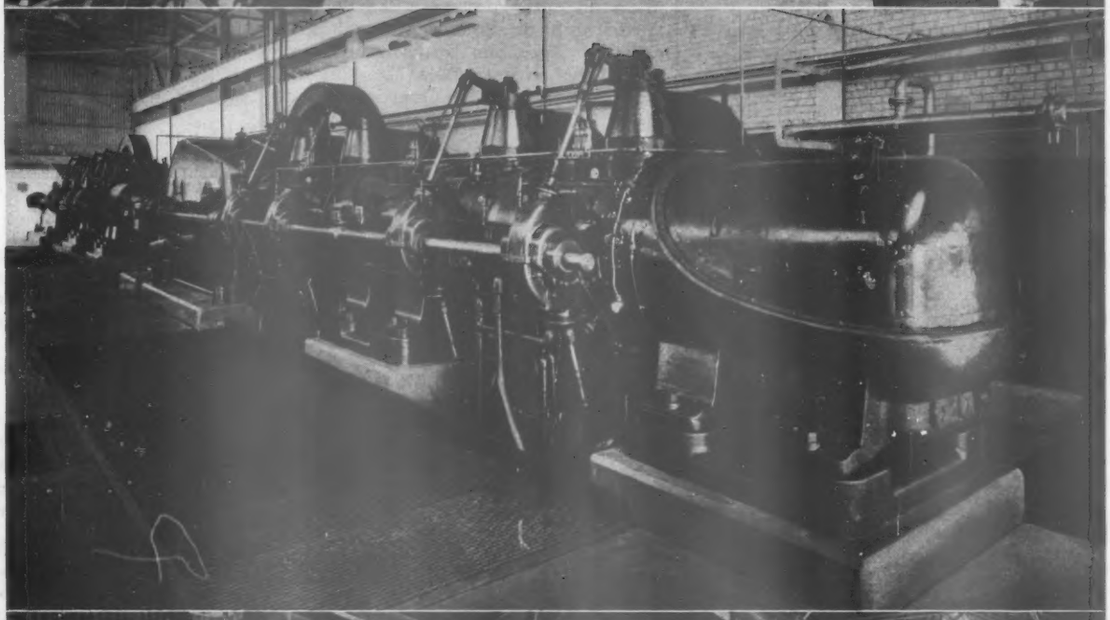
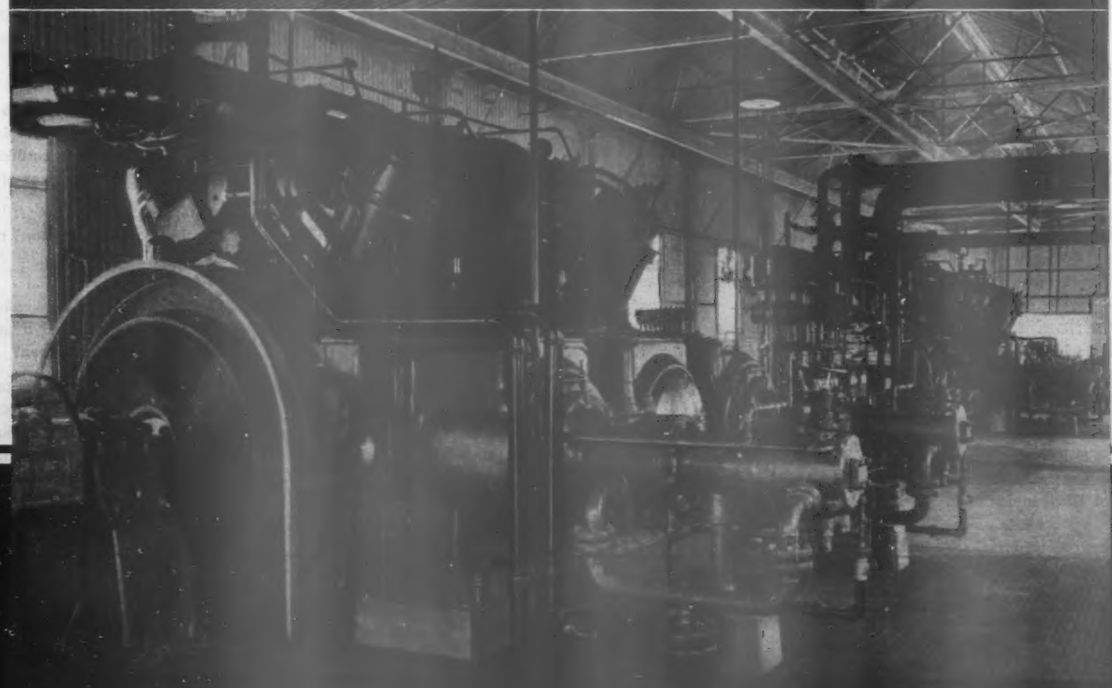
POWER...

A Type GN gas engine in refinery service. This 8-cylinder, 400 horsepower unit drives a hot-oil pump through speed increaser.



Two type 26 horizontal gas engines . . . a total of 1500 horsepower . . . driving the largest pumps of their kind in the world, in a Texas refinery.



Type G-MV v-angle compressor units in a Texas refinery. These 400 and 600 horsepower units are recycling gas and driving ammonia compressors.

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STATE CAPITALS...

CALIFORNIA

THE CONSERVATION COMMITTEE of California Oil Producers last week set the recommended oil production level for November at 613,200 bbl. per day, the same as the figure for October.

In order to maintain that figure, however, it was necessary to reduce the top allowable for any one well to 141 bbl. per day, or a total of 2,236 bbl. per day from 1,118 top wells, and to reduce production from intermediate wells by a like total amount. These two reductions were required to accommodate additional production from newly completed wells.

Discussion at the committee meeting showed some division of opinion as to the advisability of maintaining the production quota at the October level, and brought out the necessity of reducing excess production if it is to be continued. It was also pointed out that much of the high demand of the past few months could probably be expected to drop, especially in view of the coming of winter.

Joseph Jensen, who pointed out that the defense construction which had started during the early part of the year and which had caused a large consumption of gasoline and lighter oil products had nearly been completed, plead for the lower allowable and was supported by other members of the committee, but in final vote, the recommendation for 613,200 bbl. quota made by the allocation subcommittee was upheld.

OKLAHOMA

POOL ALLOWABLES were readjusted by the Corporation Commission for November, but total state-wide production was set at 428,000 bbl. a day, the same total as for October. Semiflush fields, which apparently have been producing at too high a rate, were cut down and the allowable for all prorated areas was reduced from 206,775 bbl. for October to 197,525 bbl. for November. At the same time, however, the total for unprorated areas was upped from 221,225 bbl. to 230,475 bbl.

Besides cutting the allowable for the state's semiflush pools, the commission lowered the allowable for the Oklahoma City Wilcox pool, the Guthrie field and the West Hewitt field, all of which are on the decline. The pool quota at Guthrie was reduced from 3,600 bbl. daily to 3,200 bbl., and West Hewitt was cut from 11,000 bbl. to 8,500 bbl. and Oklahoma City's Wilcox zone was put down from 74,500 bbl. to 73,500 bbl. In September the Oklahoma City Wilcox produced 73,828 bbl. daily against an allowable of 77,000 bbl.

Semiflush pools reduced in allowable were the new East Tecumseh field of Pottawatomie County, down from 2,450 bbl. to 875 bbl., with per-well allowable cut from 350 bbl. to 125 bbl.; the Avoca pool, down from 2,200 bbl. to 1,600 bbl. with per-well allowable reduced to 100 bbl., and the West Hotulke second Wilcox sand zone, down from 800 bbl. to 750 bbl. by lowering the per-well quota from 350 bbl. to 250 bbl. The West Hotulke Viola lime zone was left unchanged at 500 bbl. a day. This last area is currently one of the most active in the state.

Other changes in the November order were:

	Oct. 1	Nov. 1
North Bethel	1,700	1,600
West Bethel	150	100
East Crowell	1,400	1,200
East Cromwell-Hunton	1,500	850
Dill	2,500	2,400
South Dill	500	400
South Konawa	2,500	1,900
North Little River	275	300
North Little River-Hunton	400	160
South Maud	1,700	1,500
Oklahoma City lower Simpson	9,300	9,000
Oklahoma City dolomite	260	300
Romulus	2,500	2,000
Rusk (Walnut Bend)	650	800
North St. Louis	1,100	1,300
East Stroud-Prue	1,600	1,200
Tecumseh Lake	2,700	2,500

TEXAS

INCREASED ALLOWABLES were being urged by a campaign under way among both producers and refiners, according to reports from Houston, Tex. Spearhead of the campaign was the statement made at the October 20 state-wide hearing by Railroad Commission Chairman Ernest O. Thompson that operators should be allowed to produce all they can without waste.

Taking their cue from Commissioner Jerry Sadler's reply that "when the government tells the commission it wants oil and needs oil the request will be granted," leaders in the drive were sending wires to both the Railroad Commission and the Office of Petroleum Coordinator in Washington.

Both independent and major refiners apparently backed the move. Dan W. Hovey, president of the 11-member Gulf Coast Refiners Association said independent refiners were operating at only 70 per cent of capacity because they can't get the crude. And at the state-wide hearing, Rex Baker of the Humble Oil & Refining Co. told the commission the "Gulf Coast is not able to answer 50 per cent of the lend-lease business because crude is not available," and added that Standard Oil Co. (New Jersey) would have to seek a supply from South America if it could not get the crude in Texas.

Panhandle and North Texas producers have also been urgently pressing for increased allowables and were expected to join whole-heartedly in the campaign which originated in Houston.

THE STATE-WIDE hearing to take evidence for fixing the December allowable production was set by the Railroad Commission for November 17 at Austin.

MONTANA BOARD MEMBER . . .

S. B. COBB, Great Falls, Mont., has been appointed a member of the Montana Petroleum Conservation Board

MICHIGAN

MICHIGAN OIL PRODUCTION proration changes and some new rules and regulations for the industry, recommended by the oil-advisory board, are being put into effect by P. J. Hoffmaster, Michigan supervisor of wells, with concurrence of the state conservation committee.

Testimony taken last week resulted in approval for the changes which include 20-acre spacing for wells in Bay County's Kawkawlin field, instead of 10 acres, and an allowable of 480 bbl. per day from wells in the new Roscommon County field.

Oil-advisory-board members plan to meet in Lansing November 10 to study a proposal for 40-acre spacing for future wildcat wells and new pools as a temporary measure to conserve steel for defense. Traverse stratum production in the Reed City field goes on the same proration as from the lower Dundee-Monroe level—a rate which will be down to 220 bbl. a day, after December 1.

Because the Clare County Redding field production is thinning steadily it was agreed to lift proration there because the field at present has but nine flowing wells and few, if any, can produce more than the allowable.

KANSAS

POTENTIAL TESTS were ordered by the Corporation Commission to be taken on all oil wells in the Zenith pool of Stafford and Reno counties beginning November 10. This was the first such order issued under new rules set up by the commission effective November 1.

EMBEZZLEMENT OF OIL was charged against a Wichita oil man who was bound over to Rice County district court last week for trial. The plaintiff posted $2,000 bond in county court for his appearance in district court. The charge was filed by Atty. Gen. Jay Parker, who has been investigating alleged "hot oil" violations in the state.

NEW MEXICO

ALLOWABLE DAILY oil production for November was set by the Oil Conservation Commission at 116,500 bbl., an increase of 1,300 bbl. over the U. S. Bureau of Mines recommendation and 1,900 bbl. over the October allowable. The commission announced that the increase was ordered "in view of the rising demand for crude petroleum and the fact that for the first 6 months of this year, New Mexico's production has averaged 1,900 bbl. a day under the Bureau of Mines recommendation."

The OIL AND GAS JOURNAL

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Published weekly by The Petroleum Publishing Company at Tulsa, Oklahoma

Another Opportunity

Top officials of the C.I.O., including those of the petroleum unit, are out in the open with their plans to force a half million employes of the oil industry into their organization. A large fund has been set aside for that purpose and the methods which have been successful in other industries recently are to be brought into play.

In their announcement, the would-be dictators of all labor policies make no pretense of justifying their action. They know that the producing, refining and transportation divisions continue to lead in weekly and yearly income to employes. They know this is not the result of a temporary defense boom but is part of a general labor program with many other desirable features which predate their own organization by many years.

Nor is there any issue of the right of employes to organize. Those in charge of oil operations give employment to thousands affiliated with the craft and other unions. At no time in its history have the most radical of the older unions claimed that this industry was "anti-labor" in its negotiations with organized employes.

C.I.O. representatives have found this long record of satisfactory relations between employe and employer a great handicap in their scattered organization efforts of the past few years. It has resulted in appeals to prospective members which had nothing to do with employment conditions, accompanied by ruthless tactics on a scale known best to those who have been the victims.

A group of companies which are the industry's oldest operators are to be the first concentration point in the all-out attack. This involves a situation with which many within the oil business are not familiar.

These companies have fostered the best in industrial employment conditions. Cooperation and mutual confidence between employer and employe have been the keynote of these truly democratic activities which attracted wide attention throughout the industrial world during the twenties and during the depression period.

New Deal labor legislation forced employers to withdraw from these arrangements. The C.I.O. attempted to step into the opening that was thus created. But a large majority of the employes wanted no part of what that organization had to offer. At the same time they desired to maintain, as best they could, the direct contact with management through representatives who worked beside them in the plants and in the fields. New unions were established to represent employes.

These satisfactory associations, the C.I.O. czars have now decreed, must end. Some have frankly stated they cannot get anywhere with the oil industry generally until this solid front of opposition is broken up.

These comments are made without having discussed with the managements of the affected companies what they propose to do. As employers they are, in effect, forbidden to come to the aid of their employes in this impossible situation.

It is not necessary to explain here what this organization—improperly called a labor union—stands for and the dangers inherent in the spread of its influence in the oil business. The character of its power-mad leadership is revealed daily on the front pages of the press as it seeks to take advantage of a period of national stress to fasten its tentacles permanently on the economic life of this country.

It now appears that the administration, whose unwise legislation and subsequent coddling has made possible the growth of this body, is tiring of that which it created. Its disfavor with the general public has never been in doubt.

Oil operators have repeatedly won respect at Washington and elsewhere in their willingness to battle whenever their interests and those of the nation they serve were at stake. Another opportunity is at hand.

Watching WASHINGTON

By HENRY D. RALPH

Davies orders discontinuance of use of metal containers in distribution of petroleum products . . . Fifteen tankers scheduled to be returned to normal service . . . Price increase in Mid-Continent crude urged . . . OPC pleased with features of Arkansas conservation.

WASHINGTON, D. C., Nov. 3.—Discontinuance of the use of metal containers in the distribution of petroleum and petroleum products was ordered in formal recommendation No. 14, issued by Deputy Petroleum Coordinator Ralph K. Davies late last week. The move was taken in order to conserve steel and other scarce metals for the defense program.

Mr. Davies suggested the use of containers made of wood, glass, paper and other materials as practical substitutes for the metals used in normal times. While complete figures on the normal metal-container requirements of the petroleum industry, in tons, are not available, drum manufacturers report that in 1940 they sold 310,950 tons of steel containers to the industry.

"The needs of the defense program of the United States for steel and other metals are so urgent and in excess of the available supply that the petroleum industry must make more steel and other metals available for such defense needs by conducting its operations in such manner as to use the minimum quantity of steel and other metals and by using substitute materials wherever and whenever possible," Mr. Davies stated in his recommendation.

"Such needs are so great that the allocation of steel to drum manufacturers has already been reduced to one-third and the requirements of oil companies constitute about 57 per cent of the normal production of the drum manufacturers," he continued.

"It is also necessary to curtail the use of tin cans, tubes, and other metal containers now being employed in the distribution of petroleum and its products.

"Wood, glass, paper, and other materials offer practicable substitutes for steel, tin, and other metal containers and the manufacturers of containers from such substitutes are in position to accept orders and make immediate shipments of wood barrels and of other containers within a reasonable time."

Complete Transfer of Tankers Returned from British Service

TRANSFER of the first 15 of the 40 American flag tankers scheduled to be returned from the British shuttle service, back to use in their normal trade routes has been completed. Details as to the actual assignment of tankers in the Western Hemisphere trade are being worked out by the Tanker Control Board.

Mr. Davies released the names of the first 12 ships to be returned from their assignment of hauling oil from Gulf Coast and Caribbean ports to points north of Cape Hatteras for transshipment overseas in British tankers. They are as follows: the E. E. Powell, owned by the Atlantic Refining Co., released at the port of New York; the E. V. R. Thayer, Sinclair Refining Co., released at Providence, R. I.; the Sun Oil Co., New York; the Gulfpenn, Gulf Oil Corp., New York; the E. M. Clark, Standard of New Jersey, New York; the Trimountain, Bernuth Lembke Shipping Co., New York; the David McKelvy, Tide Water Oil Co., New York; the C. O. Swain, Standard of New Jersey, Galveston, Tex.; the Gasgoyle, Socony-Vacuum, New York; the Pan New York, Pan American Petroleum & Transport Co., New York; the LaPlacienta, Union Oil Co., New York.

The remaining 25 tankers scheduled for return to normal American operations will be turned over by the British by the end of this month.

OPM and I.P.A.A Urge Increase In Mid-Continent Crude Prices

ADDITIONAL pressure for an increase in the price of Mid-Continent crude was brought to bear upon the Office of Price Administration last week when Frank Buttram, president of the Independent Petroleum Association of America, and Rep. Wesley Disney, of Oklahoma, called upon officials of the OPA and the OPC, urging that an increase in price be permitted in order to encourage the development of necessary reserves.

Mr. Buttram submitted a cost study prepared by his association, but pointed out that the report covers conditions which are not static. The figures contained in the report, he explained, themselves indicate a trend of rapidly rising costs. A price indicated as sufficient today, he said, might tomorrow be entirely inadequate.

Mr. Disney said that he intended to meet with OPA officials this week and go over the entire situation with them prior to presenting a formal request for an increase to Price Administrator Leon Henderson.

Action on the request for an increase for Pennsylvania Grade crude is still stymied in the OPC. A report based upon a hearing at which producers of this type of crude oil and members of Congress presented detailed cost data and urged an increase in price, was forwarded to the OPC by the OPA over 2 weeks ago, but no action has been taken as yet by the coordinator's office.

The OPC in its regular weekly stock report on inventories of crude oil, gasoline and fuel oils shows that for the week ended October 25, crude-oil stocks on the East Coast were 819,000 bbl. less than the corresponding week last year. Stocks of heavy fuel oils were 2,063,000 bbl. less than a year ago. On the other hand, gasoline stocks were 589,000 bbl. in excess of the corresponding week last year, and light fuel inventories were recorded as 2,775,000 bbl. above last year's figure.

East Coast inventories of gasoline, light heating oils and heavy fuel oils on October 25 were 579,000 bbl. larger than on October 18, while refinery stocks of crude oil were 364,000 bbl. below last week's total, making a net increase in all stocks of 215,000 bbl.

Davies Expresses Satisfaction with Arkansas Conservation Structure

INDICATIONS of the proration demands which the OPC is making upon California producers and which are expected to be extended to the Illinois fields were contained in a letter addressed to Alex M. Crowell, of the Arkansas Oil and Gas Commission, by Mr. Davies last week.

While the letter was ostensibly written in praise of the "sound judgment, efficiency, and care" exercised in the administration of the state oil and gas conservation law, Mr. Davies outlined the particular features of Arkansas regulation of petroleum with which he is in accord, as follows:

1. The distinct progress realized in the elimination of unnecessary drilling accomplished by the establishment of uniform drilling units, by provision for enforced integration of small and irregular tracts into a single drilling unit, and through sound allocation of production.

2. The progress made in the proper regulation of the total rate of production of fields to within the range of efficient sustained production rates for the particular fields.

3. The allocation of the total production allowed the pool among the various properties and wells on a reasonable and equitable basis designed to prevent reasonably avoidable drainage between units or tracts.

4. The complete rejection of the individual well or some expression of its potential as the unit of allocation or as the sole or major factor in the allocation of production among tracts.

"It is doubtful that anyone would care to claim that the Arkansas law or its administration is perfect," Mr. Davies wrote. "However, constructive progress unquestionably has been made.

"It would behoove many other oil and gas producing states to look to Arkansas for guidance in the formulation or improvement of their conservation laws and administrative procedure in the application of such laws for the regulation of oil and gas development and production operations," he declared.

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LOS ANGELES EFFINGHAM, ILL. SAN FRANCISCO

Domestic Motor-Fuel Gain of 12.2 Per Cent Is Shown

DOMESTIC demand for motor fuel was maintained at a rate 12.2 per cent over 1940 through the first 8 months, it was shown this week in an analysis of the Bureau of Mines petroleum summary for August. A reduction in exports of gasoline this year lowered the overall gain in total motor-fuel demand to 10.8 per cent above the comparable period in 1940.

Domestic demand for lubricating oil is 31.7 per cent higher through August than for the first 8 months last year and this increased home consumption has finally offset the decline in exports which was a substantial factor in the demand for the first part of last year.

Demand in this country for crude oil, totaling 931,319,000 bbl. through the first 8 months, is 6.2 per cent greater than for the same period a year ago. Here again, reductions in the export demand has reduced the overall gain of 1941 to 4.5 per cent compared to 1940.

Consumption of aviation gasoline is setting the pace for 1941 product increases. Domestic demand totaling 6,705,000 bbl. during the first 8 months is 61.8 per cent above 1940. Exports, which account for nearly 50 per cent of the total United States demand for aviation motor fuel were down 2.3 per cent this year at the end of 8 months, modifying the total increase in indicated requirements to 34.3 per cent.

Export movement of all products, through the first 8 months this year, are 28.9 per cent under the total for the comparable 1940 period.

UNITED STATES SUPPLY AND DEMAND

Eight months, 1941 and 1940. (All figures in thousands of barrels)

Crude Oil

8 Months—	Total supply	Total demand	Excess demand	Excess Pct.	Domestic production	Imports	Indicated domestic demand‡	Exports	Stocks refinable crude Aug. 31‖
1941	938,615	954,038	15,423	1.6	906,943	31,672	931,319	22,719	249,620
Daily average	3,863	3,926	.....	..	3,732	130	3,833	94	.....
1940	938,014	913,204	*24,810	*2.7	911,668	26,346	877,012	36,192	264,252
Daily average	3,844	3,743	.....	...	3,736	108	3,594	148	.....
Increase, 1941	601	40,834	.....	...	†4,725	5,326	54,307	†13,473	†14,632
	0.1%	4.5%	.....	...	†0.5%	20.2%	6.2%	†37.2%	†5.5%

Refinery Products—Motor Fuel

8 Months—	Total supply	Total demand	Excess demand	Excess Pct.	Domestic production	Imports	Domestic demand	Exports	Stocks Aug. 31§
1941	444,051	448,493	4,442	10.0	443,687	364	343,963	13,530	79,205
Daily average	1,827	1,846	.....	..	1,826	1	1,790	56	.....
1940	407,810	404,696	*3,114	*0.8	407,739	71	387,833	16,863	84,836
Daily average	1,671	1,659	.....	...	1,671	3	1,590	69	.....
Increase, 1941	36,241	43,797	.....	...	35,948	293	47,130	†3,333	†5,631
	8.9%	10.8%	.....	...	8.8%	.....	12.2%	†19.8%	†6.6%
Aviation Gasoline									
1941	12,598	9,749	*2,849	*29.2	12,598	.....	6,705	3,044	7,363
1940	9,391	7,259	*2,132	*29.4	9,391	.....	4,144	3,115	5,780
Increase, 1941	3,207	2,490	.....	...	3,207	.....	2,561	†71	1,583
	34.1%	34.3%	.....	...	34.1%	.....	61.8%	†2.3%	27.4%
Kerosene									
1941	47,200	45,076	*2,124	*4.7	47,157	43	43,764	1,312	11,636
1940	48,067	46,167	*1,900	*4.1	47,999	68	43,419	2,748	9,476
Increase, 1941	†867	†1,091	.....	...	†842	†25	345	†1,436	2,160
	†1.8%	†2.4%	.....	...	†1.8%	†36.8%	0.8%	†52.3%	22.8%
Distillate Fuel Oils									
1941	126,139	123,533	*2,606	*2.1	123,227	2,912	113,243	10,290	47,163
1940	124,609	115,104	*9,505	*8.3	122,507	2,102	100,472	14,632	45,041
Increase, 1941	1,530	8,429	.....	...	720	810	12,771	†4,342	2,122
	1.2%	7.3%	.....	...	0.6%	38.5%	12.7%	†29.7%	4.7%
Residual Fuel Oils									
1941	241,950	254,284	12,334	4.9	222,585	19,365	244,957	9,327	81,268
1940	226,951	230,226	3,275	1.4	208,720	18,231	219,314	10,912	94,421
Increase, 1941	14,999	24,058	.....	...	13,865	1,134	25,643	†1,585	†13,153
	6.6%	10.4%	.....	...	6.6%	6.2%	11.7%	†14.5%	†13.9%
Lubricating Oils									
1941	25,457	27,019	1,562	5.8	25,457	.....	20,679	6,340	7,206
1940	25,243	23,928	*1,315	*5.5	25,243	.....	15,701	8,227	8,457
Increase, 1941	214	3,091	.....	...	214	.....	4,978	†1,887	†1,251
	0.8%	12.9%	.....	...	0.8%	.....	31.7%	†22.9%	†14.8%
Petroleum Wax (Thousands of Pounds)									
1941	418,250	457,698	34,448	8.6	413,280	4,970	345,146	112,552	85,824
1940	403,592	366,881	*36,711	*10.0	342,720	60,872	219,115	147,766	112,359
Increase, 1941	14,658	90,817	.....	...	70,560	†55,902	126,031	†35,214	†26,535
	3.6%	24.8%	.....	...	20.6%	†91.8%	57.5%	†23.8%	†23.6%

*Excess supply. †Decrease. ‡Crude only. §Includes finished and unfinished refinery gasoline and natural gasoline. Note: Total supply equals domestic production plus imports. Total demand equals domestic demand plus exports. Data on demand for refined products based on refinery shipments. ‖Does not include 10,942,000 bbl. of heavy oils in California. Comparable figures for August 31, 1940, 12,798,000.

Crude Oil Run to Stills and Total All Oils

8 Months—	Total imports§	Total exports§	Total crude to stills	Per cent yield gasoline‡	Natural gasoline production	Total supply all oils*	Total demand all oils*	Stocks all oils Aug. 31*
1941	56,925	66,089	914,415	43.8	40,512	1,006,677	1,025,305	544,019
Daily average	234	272	3,763	...	167	4,143	4,219	.....
1940	53,049	92,887	862,066	42.9	35,705	1,002,450	951,690	575,530
Daily average	218	381	3,533	...	146	4,108	3,900	.....
Increase, 1941	3,876	†26,798	52,349	...	4,807	4,227	73,615	†31,511
	7.3%	28.9%	6.1%	...	13.5%	0.4%	7.7%	†5.5%

*Total all oils includes crude and refined products, natural gasoline, and benzol. Stocks August 31, 1941, represented 129 days' supply, which compares to 148 days on the same date in 1940. †Decrease. ‡Does not include natural gasoline blended at refineries. §Includes crude oil and refinery products. In case of imports includes receipts in bond for domestic use but excludes "shuttle" movement. All data based on Bureau of Mines report.

Base Factors Adjusted in Canadian Gasoline Curb

The basis of rationing gasoline deliveries in Canada this month has been revised slightly, although the major objective of previous orders prevails to effect a 20 per cent reduction. Discretion as to increased or decreased deliveries to dealers has been transferred from the distributors to the Office of the Oil Controller.

In determining the November quotas, the controller has taken into consideration the averages of 3-month periods in 1940 and 1941, instead of 1-month periods upon which the October quotas were based. Instead of computing November 1941, deliveries on the basis of actual deliveries in November 1940, an average of the 1940 month plus its immediately preceding and succeeding month has been taken in order to avoid inequities caused by fluctuations in deliveries in any 1 month due to variations in dealers' inventories. An average of April, May, and June in 1941 has been taken in order to determine more accurately than the previous 1-month average the extent of the upward trend this year as it is related to comparative 1940 months.

Minimum and maximum quotas for dealers are set. The minimum is designed to provide a reasonable delivery in relation to last year to the dealer whose figures indicate a less-than-average gain. This minimum allows some latitude for unusual circumstances which may have resulted in lower figures than are justified when the present general upward trend is considered. The minimum quota is set at 88 per cent of the estimated normal requirement for November 1940.

The maximum quota sets 108 per cent of the estimated normal requirement for November 1940 as the figure beyond which supplies cannot be delivered except by permission of the oil controller.

Crude Oil Pipe Line for Gato Ridge, Calif., Is Discussed

It is reported that plans for a crude-oil pipe line from Gato Ridge field near Los Alamos, Calif., to a marine loading station between Casmalia and Point Sal have been completed, but there is doubt that it will be built immediately. In the first place tankers are so scarce on the Pacific that it is doubtful whether movement for the oil could be obtained after a line to tidewater had been provided. Meantime, oil is now moving out of the field in tank trucks.

International

Mexico . .

Crude-Oil Production Is At Lowest Recent Level

PRODUCTION of 97,500 to 98,000 bbl. in September, the lowest point to which Mexican crude-oil output has fallen in a number of years, is indicated for September on the basis of yield reported by Petroleos Mexicanos, the government petroleum agency. The indicated-production figure does not include yield from properties of "independents" who were not included in the 1938 expropriation decree. Normally, independents produce about 4,500 to 5,000 bbl. per month and remainder of the Mexican output is handled by Petroleos Mexicanos.

Crude produced by Petroleos Mexicanos in September declined to 93,454 bbl. daily compared to recovery of 95,215 bbl. daily from the same properties in August. Most of the September decline was in the Poza Pica field which skidded 50,000 bbl. below the August output.

Production for the entire country in August, the last month for which inclusive figures are available, averaged 99,348 bbl. daily compared to 123,857 bbl. daily in July and with 125,764 bbl. daily in August 1940.

Poza Rica production, which accounts for about 65 per cent of the Mexican total crude yield, dropped from 2,485,540 bbl. in July to 1,764,370 bbl. in August, a decline of 721,170 bbl. The other three main producing districts declined by smaller amounts in August.

Details of August production for the entire country and for Petroleos Mexicanos only in September are given in the following tables:

PETROLEOS MEXICANOS PETROLEUM PRODUCTION

	August		September	
District—	1940	1941	1940	1941
N. Tampico	315,140	361,435	393,485	366,120
S. Tampico	420,005	332,950	323,495	363,190
Poza Rica	2,531,485	1,764,370	2,521,025	1,714,440
Isthmus region	457,405	492,920	429,075	453,310
Total	3,724,035	2,951,675	3,667,080	2,897,060
Daily av.	120,130	95,215	118,293	93,454

TOTAL MEXICAN PRODUCTION

	August		July
	1940	1941	1941
North Tampico	453,075	440,075	448,820
South Tampico	456,960	382,410	404,030
Poza Rica	2,531,285	1,764,370	2,485,540
Isthmus region	457,370	492,925	501,170
Total	3,898,690	3,079,780	3,839,560
Daily average	125,764	99,348	123,857

Brazil . .

ALTHOUGH legislation has been enacted which paves the way for the financing by foreign interests of an oil refinery in Brazil, the plant, which has been projected for some time, may not be built because of the difficulty of obtaining the necessary equipment from the United States, as well as obstacles to getting the crude oil. A refinery having a daily capacity of between 10,000 and 20,000 bbl. had been discussed with an American refinery-construction firm, it is understood. Recently Brazil obtained a large loan from the United States, which placed the nation in a position to consider the building of the plant.

Meanwhile, Brazilian authorities are reported to be studying means of counteracting the shortage of imported petroleum. Because of the scarcity of oil-tanker tonnage, there has been a reduction in such imports this year. In the first 6 months of this year gasoline imports amounted to only 151,814 metric tons, against 185,677 tons in the corresponding period of 1940, while fuel-oil imports contracted from 236,032 tons in the first half of last year to 175,394 tons this year. At the same time Brazilian oil needs have increased as a result of the expansion of manganese and other industries. Inventories of petroleum products also have reached a low point, it is said.

The lease-lend agreement recently signed between Brazil and the United States involved a loan of about $100,000,000 to be used in defense installations and to be repaid by the export of strategic materials. Reports have been current that despite obstacles, efforts to obtain equipment for the construction of the refinery would be continued, in view of the fact that additional oil supplies will be required to enable Brazil to carry out its end of the agreement. The possibility of obtaining Mexican crude oil for the plant, if it is actually built, has been considered.

Uruguay . .

Ceiling Placed on Oil Prices and Consumption

OWING to the present shortage of kerosene, the president of the republic decreed August 12 its maximum selling price to the public within the Department of Montevideo at 11 centesimos per liter (1 centesimo=$0.004). Prices in the other departments of Uruguay will be established by the respective subsistence committees, on the basis of the Montevideo price, plus transport cost.

As a fuel-conservation measure, the Uruguayan Government has restricted sales of gasoline and fuel oil 30 per cent to all users except public utilities and farmers.

Argentina . .

Consummation of Trade Pact Revives Pipe Line

SIGNING of a trade agreement between the United States and Argentina has resulted in the circulation of reports that a major pipe-line project to move crude oil from the Mendoza fields to a tributary of the River Plata would be revived. The project originally called for an 800-mile line which would give western Argentina's large potential producing areas an outlet to more densely populated areas in the East and possibly to world markets.

Output of the Mendoza oil fields has been increasing steadily. The fields produced 1,880,114 bbl. in the first 7 months of this year, compared with 2,500,000 bbl. in the entire year 1940 and only 785,000 bbl. in 1939.

It is known definitely that the pipe-line project has figured in discussion in Washington, but authorities have failed to indicate whether the pipe line actually would be built at this time.

According to the Argentine "Boletin de Informaciones Petroleras," the production of Argentine oil refineries in 1940 increased to 24,877,000 bbl. from 23,524,000 bbl. in 1939. Of significance, however, is the fact that a substantially larger proportion of the 1940 refinery output was contributed by Argentine Government owned plants than in 1939. Government-owned refineries produced 13,259,000 bbl. in 1940, compared with 10,425,000 bbl. in 1939, a gain of about 28 per cent. Privately owned refineries in 1940 produced only 11,618,000 bbl., compared with 13,099,000 bbl. in 1939, a decrease of approximately 11 per cent.

The following table shows Argentine refinery output in 1939 and 1940 by products (figures in barrels):

	1939	1940
Aviation gasoline	72,000	76,000
Motor gasoline	8,538,000	7,998,000
Solvents	105,000	95,000
Kerosene	622,000	1,257,000
Gas oil	682,000	876,000
Tractor fuel	692,000	334,000
Diesel oil	1,873,000	2,179,000
Liquefied gas	58,000	72,000
Lubricating oils	512,000	443,000
Fuel oil	7,866,000	9,093,000
Grease	5,000	11,000
Asphalt and emulsions	293,000	371,000
Coke	495,000	430,000
Still gas	506,000	376,000
Miscellaneous and losses	1,205,000	1,266,000
Total	23,524,000	24,877,000

Total crude-oil output in Argentina in 1940 was 20,486,000 bbl., compared with 18,613,000 bbl. in 1930. Domestic demand for petroleum in 1940 reached a new high record of 32,850,000 bbl. compared with 32,103,000 bbl. in 1939. Despite this growth in demand, imports decreased to 13,448,000 bbl. in 1940 against 14,278,000 bbl. the preceding year, a reflection of the government's efforts to attain self-sufficiency in petroleum resources.

Colombia . .

Crude Production Holding At 68,000 to 69,000 Bbl. Daily

PETROLEUM production improved slightly in July 1941 to 2,118,981 bbl. from 2,077,936 in the preceding month. The volume of crude petroleum refined was 254,611 bbl., compared with 263,682 in June. However, the daily average output of 68,354 bbl. in July compared to 69,262 bbl. daily in June. Crude-petroleum exports of 2,529,652 bbl. showed a material gain over June shipments of 1,533,276 bbl.

Details of Colombian production of petroleum products are:

(In barrels of 42 United States gallons)

Products—	June 1941	July 1941
Gasoline	87,537	84,644
Ethyl gasoline	2,277	3,249
Kerosene	10,284	12,279
Power kerosene	6,287	.....
Fuel oil	107,342	130,988
Gas oil	16,365	12,552
Residual fuel oil	1,432	1,272
Asphalt	3,895	4,969
Lubricants	.....	4,845
Naphtha	537	172
Dry cleaning fluid	529	531
Crude topped ("crudo reducido")	83,306	49,306

Geologic Introduction Opens Fall Meeting of A.I.M.E.

(Continued from Page 60)

tions of wet gas and inclined oil-water contact surfaces.

The geologist in recent years has come to depend more and more upon the petroleum engineer for developing the picture of the geologic section in proved areas. Continued and expanding cooperation between geologist and petroleum engineer will, in Mr. Hoots' opinion, be of immense value both in finding and producing oil.

Presiding Officers

The Wednesday morning session, at which Mr. Hoots' address was delivered, was presided over by W. H. Geis, assistant to the president of Union Oil Co. Chairmen for the other sessions were E. K. Parks, Los Angeles engineering consultant; C. P. Watson, vice president of Seaboard Oil Co., and John F. Dodge, head of the department of petroleum engineering at the University of Southern California. Other papers presented at the 2-day sessions are presented elsewhere in this issue in condensed form.

Between 450 and 500 A.I.M.E. members and guests were in attendance at the meeting. Out-of-state members registering included John R. Suman, president of the A.I.M.E. and vice president of Humble Oil & Refining Co.; T. V. Moore, in charge of production research for Humble; C. P. Parsons, vice president of Halliburton Oil Well Cementing Co.; Basil B. Zavoico, chief geologist of the department of petroleum economics, Chase National Bank; A. Irving Levorsen, consulting geologist of Tulsa; Paul M. Raigorodsky, assistant director of production at the Office of the Petroleum Coordinator in Washington, D. C.; E. De Golyer, director of conservation at the Petroleum Coordinator's Office in Washington; Charles Ripamonte, engineer for the Argentine Government oil fields at Buenos Aires; B. H. van der Linden of Asiatic Petroleum Corp.'s New York headquarters; R. E. Watson, production engineer for Standard Oil Development Co., New York; C. V. Millikan of Amerada Petroleum Corp., at Tulsa; W. S. (Buck) Morris, field chairman of the East Texas Engineering Association at Kilgore; Carl A. Young, secretary of the Production Division of the American Petroleum Institute at Dallas; P. E. Fitzgerald, research geologist for Dowell, Inc., at Tulsa; A. F. Lager, of Siosi Oil Co., at Terre Haute, Ind.; A. R. Denison, geologist for Amerada Petroleum Corp. at Tulsa; W. B. Emery, chief geologist, J. D. Wheeler, division petroleum engineer, all of Ohio Oil Co., at Findlay, Ohio; Eugene A. Stephenson, chairman of the A.I.M.E. Petroleum Division and head of the petroleum engineering department of the University of Kansas; A. B. Parsons, secretary of the A.I.M.E. at New York; Chester Naramore and E. J. Kennedy, Jr., both of the A.I.M.E. New York offices.

The program of the meeting was arranged by L. E. Porter, chief engineer for Richfield Oil Corp. There was no election of officers. Harry P. Stolz, a partner in the Los Angeles consulting engineering firm of Stanley & Stolz, who has been called to active duty as lieutenant commander in the office of the inspector of naval petroleum reserves in California, has been nominated for chairman of the Petroleum Division of the national A.I.M.E. Since this is tantamount to election, Mr. Stolz will replace Eugene A. Stephenson in February. C. P. Watson will be in charge of arrangements for the regional A.I.M.E. meeting which will take place in Los Angeles a year from now. Walter Abel, engineer with the Corporation Commission of California, will again be secretary-treasurer.

An informal dinner dance at the Cocoanut Grove Ballroom of the Ambassador Hotel on Thursday night concluded the convention.

Overland Crude Movement to East Increases 138 Per Cent

WASHINGTON, D. C., Nov. 5.—Overland movement of crude oil into District 1 increased by 138 per cent between May and September of this year, it was reported tonight by the OPC. Shipments of crude by barge, pipe line, tank car and tank truck in May amounts to 1,222,000 bbl. as compared with 2,917,000 bbl. during September.

Shipments by various transportation agencies in May as compared with September were as follows (figures in barrels): Pipe line, 952,145 and 1,454,297; combination pipe line and tank car, none and 551,219; combination pipe line and barge, 259,980 and 261,500; railroad tank car, 10,038 and 560,054; tank truck, 191 and 312; combination pipe line and tank truck, none and 43,626; combination tank car and barge, none and 46,284. Totals, 1,222,354 bbl. during May and 2,917,292 bbl. during September. The figures came from a report to the OPC by the District 1 transportation committee, headed by W. A. Jones, of New York.

DEATHS

F. R. LOWELL, manager of engine sales for National Supply Co., was killed in an airplane crash on the Northwestern lines near Fargo, N. D., October 30.

HAMILTON RIDDELL SMITH, 65, secretary-treasurer of Louisville Refining Co., Louisville, Ky., died at his home in Louisville of a heart attack. A native of Irvine, Ky., Mr. Smith formerly lived at Lexington, Ky., where he was associated with Great Southern Refining Co. A daughter survives.

HARRY G. MORRIS, secretary-treasurer, Maple Leaf Oil Co., at one time active in the Wainwright field in Alberta, died at Vancouver, B. C., last week.

JAMES ALEXANDER VAUGHN, 54, former Tulsa manufacturer and oil broker, died October 31 after an illness of several years. The widow and three daughters survive.

FRANK LESLIE ELLIOTT, 72, retired drilling contractor of Albany, Tex., died October 31. The widow and two daughters survive.

CHARLES W. HANN, 74, retired engineer of South Penn Oil Co., died in a fire that damaged the home where he was a boarder. Death was attributed to suffocation.

J. K. LONG, drilling superintendent for Taylor Drilling Co., with headquarters in Falls City, Neb., was killed last week in an automobile accident near Falls City. His widow and two sons survive.

CAPT. E. N. STANLEY, 50, who went to Kilgore, Tex., 8 years ago to take charge of the Texas Railroad Commission's office which was beginning to supervise proration of East Texas oil fields, died at Port Arthur, Tex., where he had gone to hunt ducks. Survivors include his widow and two sons.

J. N. FLANAGAN, 53, oil producer, Midland, Tex., died at a Tulsa hospital this week following a 2-week illness. He was en route to the Mayo Clinic at Rochester, Minn., when he had to go to a hospital. Prior to his operations in Texas, Mr. Flanagan had operated in Pennsylvania.

New Attendance Record Set At Fall C.N.G.A. Meeting

(Continued from Page 62)

for the product have averaged from two to three times the price of normal butane. The isomerization and dehydrogenation of butane into isobutane, however, will tend to decrease this ratio in proportion to the percentage of conversion less the cost of processing. It will also increase the use of butane for the benefit of national defense while making more room for the use of propane as a fair substitute for the numerous uses of butane at present.

Butane Potentialities

"It is estimated that over 35,000 bbl. a day of butane can be made available in the natural-gasoline industry for dehydrogenation or isomerization without substantial expenditure on the facilities for its production. This volume combined with available isobutane would produce almost 50,000 bbl. a day of alkylate of 94 octane. Assuming a blend of 60 per cent of alkylate with 40 per cent of aviation straightrun of 70-74 octane and some isopentane, it may permit manufacturing 80,000 bbl. a day of 100-octane aviation gasoline. Natural gasoline is performing yet another direct service in extensive efforts at increase of aviation-gasoline production. Butylenes and isobutane removed as components of refinery motor fuel for their use in synthesizing the high-octane fuels required in or as aviation gasoline, create in most cases submornal vapor pressures in the remaining motor-fuel stock. Natural gasoline or butane or both may be and are employed to restore or impart the volatility characteristics necessary for the balanced motor fuel." The inference all through the meeting was that the California natural-gasoline industry would be expected to greatly increase production of isobutane. This must have been a source of much gratification to S. F. Magor, head of the natural-gasoline department of Superior Oil Co., because he pioneered refrigeration in the production of natural gas and isobutane. Superior's natural-gasoline plant in the Kettleman North Dome field was the first plant to use refrigeration on a commercial scale and this plant is one of the largest producers of isobutane. Construction and operation of this plant appeared in The Oil and Gas Journal, August 15, 1940.

R. E. Miller, president of the Natural Gasoline Association of America; W. F. Lowe, secretary, and H. H. Beeson, vice president and chairman of the technical committee, attended the meeting. In addition to the officers of the N.G.A.A., the California association also featured a paper by George P. Bunn, of Phillips Petroleum Co., who discussed "Human Engineering in the Petroleum Industry," which dealt primarily with the personnel problem. The paper on "Natural-Gasoline-Plant Practice as Applied to Cycling," by P. C. Dixon, of Foran, Boatright and Dixon, covered the location and completion of wells, reservoir efficiency, operation of wells as part of the plant, selection of materials, design and operation of various plant units, selection and care of absorption oil and operation of field lines.

The meeting was brought to a climax with a banquet and stag show at the Ambassador Hotel in Los Angeles.

Magnetic Storm

TUCSON, Ariz.—A moderate magnetic storm began October 30 at 9 p.m., and ended November 1 at 2 p.m., central standard time.

Recycling News

Aviation-Fuel Need Spurs Recycling-Plant Program

Expansion of aviation-gasoline output has given rise to proposals for a number of recycling projects along the Gulf Coast fields, latest of which was the program of the Humble Oil & Refining Co. for the Katy field of Waller County, Texas, about 25 miles northwest of Houston. While the Office of Production Management in Washington announced that its analysts had recommended one of the highest national-defense priority ratings for materials for the plant (A-1-C), engineers of the Humble company reviewed details of the program before the Railroad Commission at Austin, Tex.

The proposed plant, composed of both recycling and absorption units, will process 200,000,000 cu. ft. of gas daily. Construction and equipment will cost around $2,500,000.

Humble and associates have unitized practically all of the Katy gas field for drilling additional wells to supply the plant which is expected to start with production from 15 gas wells. At present there are 13 producing wells in the field. Two of these are to be converted into injection wells and four more injection wells and four more producers are to be drilled.

Joe Miller, Humble company engineer, told the commission that the maximum recovery was 1 gal. per 1,000 cu. ft., or 22 bbl. per 1,000,000 cu. ft. The absorption plant is to operate at a pressure of 1,500 to 1,800 lb. Some of the tail gas will be sold to the United Gas system, but the remainder will be injected into the reservoir if commission approval is given. Final approval of the recommended priority rating is expected this week.

Meantime, it was learned that OPM has granted priority rating A-1-C for materials to add to an isobutane unit to the La Gloria Corp.'s recycling plant in the La Gloria field on the lower Gulf Coast. The present capacity of 200,000,000 cu. ft. daily would be increased by 50,000,000 cu. ft. under the expansion project. The plant was recently completed at a cost of $2,000,000.

A number of other recycling plants are planned for the area. OPM has application for a priority rating for materials for a 50,000,000-cu. ft. plant in the North Houston area of Harris County. This, it was understood, will be built by Distillate Producers Corp., incorporated by a Houston group, on acreage farmed out by the United Gas Corp.

Another group of Houston men is planning a recycling plant in the North Tepetate field of coastal Louisiana. Geier Brothers and F. B. Jackson, Jr., have a project in the Grapeland field in the East Texas area (see below) and a second recycling plant is being planned in the Alice area of Jim Wells County, where W. R. Davis, Inc., has already constructed a unit. Joyce Richardson and Christian Carpenter have started a plant in the Richardson field northwest of Houston.

Grapeland Plant Proposed By Geier-Jackson Company

Plans for construction of an absorption plant in the Grapeland field, Houston County, Texas, were outlined last week at a hearing before the Texas Railroad Commission in Austin by F. B. Jackson, Jr., partner in the Geier-Jackson Recycling Co.

Mr. Jackson said the plant, which would be of 50,000,000 cu. ft. daily capacity, would recover pentanes and perhaps some butane and propane. The company has 3,100 acres with seven wells, six of which produce gas and one of which is used as an injection well.

It was stated that all the wells produce from only one sand at 6,000 ft. and that the company can get about 47 bbl. of liquid per 1,000,000 cu. ft. of gas processed. The plant would operate at an intake pressure of 1,800 lb., and an injection pressure of from 2,400-2,500 lb. would be used. All tail gas would be returned to the sand.

Natural Gas

Natural-Gas Consumption Is 18 Per Cent Above 1940 Rate

Sales of natural gas in July were more than 18 per cent greater than for the same period in 1940, the American Gas Association reported last week. Industrial and commercial consumption and utilization in electric generation account for a large bulk of the increase, although domestic demand, according to A.G.A. statistics, is up 2.6 per cent.

Natural gas consumed for industrial purposes and in electric generation during July totaled 84,216,000,000 cu. ft., an increase of 21.3 per cent. Industrial consumption alone totaled 65,009,000,000 cu. ft., a gain of 25.2 per cent compared with the same month last year. Commercial consumption is up 14 per cent.

For the first 7 months, natural-gas consumption by industrial accounts was 17.1 per cent higher this year than in 1940 which is the reason for the increase in total demand which is up 9.4 per cent over 1940.

Billings Gas Co. Spends $400,000 for Expansion

Billings Gas Co. is spending $400,000 in building a plant in Garland field, Big Horn County, Wyoming, a gas-compressor plant in Elk Basin field, Park County, Wyoming, a 21-mile 8⅝-in. pipe line to connect the two fields, and other improvements. Elk Basin has supplied the line for 20 years, and additional reserves were required, in addition to compressors.

Canadian System Expands to Meet Increase in Gas Use

EDMONTON, Alta.—Work will be started this month by Northwestern Utilities, Ltd., on the duplication of 7 miles of the company's main transmission line from the Viking field to Edmonton. The work was planned earlier as part of the company's $500,000 1941 construction program, but has been delayed through difficulty in securing the necessary 12¾-in. pipe. The company drilled five new wells in the Kinsella field which aggregated potential of 71,000,000 cu. ft.

Refinery Expansion

Port Arthur Refinery Will Increase Output of Aviation Gasoline

Officials of the Gulf Oil Corp. have released additional details of the 2,500 bbl. aviation-gasoline unit to be constructed at its Port Arthur, Tex., refinery. Construction is to start in about 3 months. It will cost considerably more than $1,000,000 and will include a Houdry catalytic cracking unit to produce base stock and an isooctane plant to produce alkylates to blend the stock into 100-octane fuel. When completed it will increase aviation-gasoline production at the Port Arthur refinery from 1,500 bbl. to 4,000 bbl. a day.

Predict Industry Will Be Asked To Double Toluene Production

SAN FRANCISCO, Calif., Nov. 4.—The petroleum industry probably will be called upon to double its present production of toluene, Dr. Gustav Egloff, of the Universal Oil Products Co., said today in an interview. The output of plants under construction or completed total 100 million gallons, he said, of which 70 per cent comes from petroleum and the remainder from coal carbonization. He gave figures showing that the production of toluene from petroleum was substantially cheaper than from coal tar. He estimated that the Government will need 200 million gallons of toluene in the production of explosives. At this time, he said, the 70-million-gallon output of the petroleum industry is accounted for by the 30-million-gallon output of the new toluene plant of the Humble Oil & Refining Co., 30 million gallons from smaller plants of the same type and 10 million gallons from extraction plants. According to Dr. Egloff, recoveries up to 50 per cent of toluene are obtained from fractions of gasoline having the properties required for the production of the explosive material.

Substitute for Chlorine Used In Tetraethyl Lead Process

Ethyl Gasoline Corp. announced this week that by substituting hydrochloric acid for chlorine in the manufacture of tetraethyl lead it will make over 1,000,000 cu. ft. of chlorine gas available daily to ease national shortages in this defense chemical. Raw materials consumed by the manufacture of hydrochloric acid will be common salt and sulfuric acid. Large quantities of salt, and sulfur to make the acid, are mixed near Ethyl's Baton Rouge, La., manufacturing plants

A saving of critical months will be effected by this substitution, it is stated, as over a year would be required if the Government had to provide new chlorine capacity equal to that which will be freed when the hydrochloric acid plant is completed next spring.

Hydrochloric acid does not enter the tetraethyl lead reaction, but is used in the manufacture of an important intermediate, ethyl chloride. Most industries using chlorine cannot utilize hydrochloric acid as a substitute, it is pointed out. The particular chemistry of the tetraethyl lead industry permits this substitution.

Construction of additions to Ethyl's Baton Rouge plants at a cost of $2,500,000 will be speeded with the aid of government priorities that rate this project as vital to national defense.

Contract Drillers Protest Ruling On Depletion Allowances

WASHINGTON, D. C., Nov. 3.—Problems of the oil industry in connection with depletion allowances now in effect by which cost of labor, fuel, transportation of materials, and many other costs in connection with the drilling of oil wells would be no longer permitted to be deducted from income for tax purposes under the terms of "confidential instructions" recently sent out to the field offices of the Internal Revenue Bureau, were discussed today at a meeting of contract drillers, major oil-company representatives, representatives of independent oil companies, and officials of the Internal Revenue Bureau.

Under the new instructions which are based upon rulings of the Board of Tax Appeals in the Retsal and Ambrose cases, deductions would only be allowed to be made when sums spent by the contract driller were spent under a contract which provides an employer-employe relationship between the operating company and the contract driller.

J. E. Brantly, representing the American Association of Oilwell Drilling Contractors, pointed out that from 90 to 95 per cent of all oil wells are drilled under contracts based on footage charges. Enforcement of the new instructions, he said, would force every contract driller out of business and would result in a depletion of reserves, as well as eliminate the drilling of many new wells at a time when the national-defense effort is calling for a building up of reserves and the drilling of more wells than ever before.

Under these instructions, he declared, no operating company could afford to utilize a contract driller to drill its wells and would instead be forced to drill its own wells, which would cause a dislocation in the industry "so immense as to seriously delay and interrupt the defense program as applied to the petroleum industry."

Robert E. Allen, director of production of the Office of the Petroleum Coordinator, stated that he was "glad to concur with everything Mr. Brantly said." The interest of the OPC, he declared, is primarily to see that adequate supplies of petroleum are made available for both military and civilian uses, and that new reserves are built up to assure our supply of petroleum. This could not be done under the "confidential instructions," he said.

Dale H. Flagg and Ellis W. Manning, of the general counsel's office of the bureau, and D. W. Williams, chief of its natural resources division, were sympathetic to the requests of the industry representatives, but pointed out that they are bound by the code and the rulings of the Board of Tax Appeals and court decisions. At the present time, Mr. Flagg pointed out, they have no alternative but to require the employer-employe relationship in order to permit deduction of intangibles.

Lloyd Noble, Noble Drilling Co., Tulsa, stated that enforcement of such a ruling would completely disrupt the drilling business and would do unforeseeable damage to the entire industry.

Mr. Williams told the industry representatives that the natural resources section does not want to make any rulings which would do anything to upset the industry with respect either to producers or contractors. Mr. Manning asked that briefs be filed within the next 10 days setting forth legal opinions in opposition to the ruling.

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Encouragement Given Supply Men by Priorities Specialist

By T. P. SANDERS

SAN FRANCISCO, Calif., Nov. 3.—The Petroleum Equipment Suppliers Association at the annual A.P.I. convention received with gratitude a strong note of encouragement brought to their meeting today by James E. Hughes, priorities specialist of OPM in Washington, D. C. In general terms, Mr. Hughes outlined a new order, designed along the lines of the defense supply-rating plan which will apply to the entire oil industry.

Mr. Hughes was introduced by W. L. Childs, president of Reed Roller Bit Co. and priorities representative for the petroleum equipment suppliers at the recent Washington conferences. Reminding his audience that priorities do not make scarcity, but are intended only as a necessary measure for taking care of shortages arising from the war effort, Mr. Hughes voiced his opinion that the situation is far from being so desperate that essential industries, such as the oil, will have to be denied much-needed materials.

As chief coordinator between the OPM and the petroleum coordinator's office, Mr. Hughes believes that the petroleum industry should be able to get the materials it needs quickly through the supply houses, which carry its inventories. He attributed past priorities difficulties to the desire of the petroleum coordinator's office to formulate too perfect a plan before putting it into effect.

The new order is not written to limit what can be received by the oil industry, but rather to allow the industry all the materials that can be spared. Its purpose is to get materials into the supply houses, not on the basis of supplying orders as they are approved by the OPM, but on a basis of meeting the known demand indicated by past records in so far as possible. The supplier will be required to show the proper papers proving that the material reached the oil industry.

The new order will eliminate the use of Form PD-1 on most equipment not directly required by the military forces. Form PD-1 will be used to supplement the new order, thereby making it possible to obtain a higher priority rating than A-8, which the order provides for the petroleum industry as a whole, if a higher rating is needed to obtain necessary equipment.

In answer to a request from Mr. Childs, Mr. Hughes said he had in his pocket a copy of the order, and had made the trip to San Francisco to invite the help of the industry in making the new system as practical and workable as possible. Mr. Childs replied that a committee had been appointed shortly before the meeting to work with Mr. Hughes. It was agreed that cooperation of the oil companies, as well as the supply companies, would be absolutely necessary to make the new plan work. With characteristic frankness, Mr. Hughes warned that the new order would require more paper work, which was unavoidable, and no very definite benefits could be expected before January 1.

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CALENDAR

November

AMERICAN ASSOCIATION OF OIL-WELL DRILLING CONTRACTORS, first annual meeting, Dallas, Tex., November 13-14.

SOCIETY OF AUTOMOTIVE ENGINEERS, natiinal transportation and maintenance meeting, Statler Hotel, Cleveland, Ohio, November 13-14.

December

EXPOSITION OF CHEMICAL INDUSTRIES, eighth annual meeting, Grand Central Palace, New York, December 1-6.

NEW MEXICO OIL AND GAS ASSOCIATION, Artesia, N. M., December 3.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Southeastern district meeting, New Orleans, La., December 3-5.

OKLAHOMA STRIPPER WELL ASSOCIATION, Tulsa, December 5.

1942

January

SOCIETY OF AUTOMOTIVE ENGINEERS, annual meeting and engineering display, Book Cadillac Hotel, Detroit, Mich., January 12-16.

THE MARKETS*

CRUDE OIL: Rumors are gaining momentum that the Office of Price Administration is taking a liberal view of figures supplied by Mid-Continent producers in support of a plea that rising costs justify higher crude postings. There is no confirming evidence from Washington, D. C., however. Meanwhile, the crude market remains unchanged, excepting for the gradual spread of premiums in order to hold connections or gain new ones in areas of strongest buyer pressure.

REFINERY PRODUCTS: Markets are unchanged. Inclement weather in parts of the country and return of tankers to the East Coast trade have eased the demand for gasoline in the northern and eastern sections of the country but the price structure in primary-supply centers is firm and unchanged. There are no reports of distress gasoline in any part of the country.

TANK WAGON AND POSTED DEALER: Conditions remain static. Despite the freer movement of motor fuel to the East Coast, stations in that section of the country are continuing their 12-hour closing program.

FINANCIAL: Oil stocks moved over a narrow range, closing slightly lower than in the previous week. Average of 30 representative stocks for week ended November 1: High, 26.86; low, 26.09; close, 26.54. Week ended October 25: High, 26.75; low, 25.41; close, 26.62.

*Detailed information in the market section.

Among those boarding The Oil and Gas Journal Special at Tulsa were: (1) Frank H. Dunn, executive vice president, H. F. Wilcox Oil & Gas Co.; John C. Day, secretary, Western Petroleum Refiners Association; H. D. Skyrm, General American Tank Car Co.; R. F. Pielsticker, executive assistant, Skelly Oil Co. (2) J. F. McManmon, National Bank of Tulsa; Ed I. Hanlon, chairman, Hanlon-Buchanan, Inc.; Dana Kelsey, vice president, Sinclair Prairie Oil Co.; E. H. Moore, president, E. H. Moore Co.; and D. E. Horrigan, vice president, Papoose Oil Co. (3) John Mabee, president, Mabee Oil & Gas Co., and George P. Walton, sales manager, Unit Rig & Equipment Co. (4) Howe Walker, Mid-Continent manager, Hughes Tool Co.; H. L. Putnam, National Supply Co.; W. K. Warren, president, Warren Petroleum Co.; O. A. Bergman, Spang Chalfant, Inc., and W. B. Way, general manager, International Petroleum Exposition. (5) C. S. Sanders, general superintendent, Stanolind Oil & Gas Co., and Cecil C. Forbes, manager, Noble Drilling Co. (6) Phil H. Bohart, vice president, Gulf Oil Corp.; Rush Greenslade, vice president, Gulf Oil Corp., and Elmo Thompson, president, Superior Oil Co. (7) F. P. Walter, investments; A. E. Bradshaw, president, National Bank of Tulsa; Clyde H. Pape, general manager, Selby Oil & Gas Co., and Burdette Blue, attorney, former president I. T. I. O.

Oil Men Laud Journal's Trains

SAN FRANCISCO, Calif., Nov. 2.—High praise for the Journal's two special trains came from 250 men and women when they arrived here this morning to attend the twenty-second annual meeting of the American Petroleum Institute. The two crack Santa Fe streamliners—one leaving Chicago Friday at 11 a.m. and the second train from Tulsa, 4 p.m. Friday—arrived here at 8:30 a.m. today, a half hour ahead of schedule. The trains established new records in time for Santa Fe trains to San Francisco from the two points.

"The most enjoyable train ride I have ever had," said one Mid-Continent operator who has made the trip to California many times. His comment was typical of others coming from points as far east as New York. Most of the operators on the trains were from Ohio, Illinois, Kansas and Oklahoma.

As promised, the Journal-sponsored trains afforded the best in rail transportation from "stem to stern," making it possible for passengers to renew acquaintanceships and make new friends under comfortable traveling conditions.

The Journal's news and football services at Needles, Calif., were particularly appreciated. The Tulsa, Washington, New York, Houston and Los Angeles editorial offices summarized the day's oil news and this was made available to the passengers of both trains at Needles. At the same time, each passenger was given a report with the final scores of 60 principal football games played Saturday afternoon.

List of Passengers Boarding Train at Tulsa

A. G. Bailey, Fred E. Cooper Co.; G. S. Bays, Stanolind Oil & Gas Co.; O. A. Bergman, Spang Chalfant, Inc.; Burdette Blue, attorney; P. H. Bohart, Gulf Oil Corp.; Mrs. Geo. Bole; Mr. and Mrs. W. M. Bovaird, Bovaird Supply Co.; Joseph Bowes, Oklahoma Natural Gas Co.; all of Tulsa.

I. S. Boydstum, Tret-O-Lite Sales, Houston, Tex.; A. E. Bradshaw, National Bank of Tulsa, Tulsa; Clay Briggs, Cities Service Oil Co., Bartlesville, Okla.; J. H. Brooks, Republic Supply Co.; Mr. and Mrs. D. E. Buchanan, Hanlon-Buchanan, Inc.; A. E. Butts, A. O. Smith Corp.; Mr. and Mrs. Arch Campbell, Waukesha Motor Co.; L. C. Collins, Westland Oil Corp.; N. R. Crawford, Dowell, Inc., Tulsa.

P. H. Dahlgren, Foster Petroleum Co., Bartlesville, Okla.; B. D. Dawson, Tansel Petroleum Co., Minneapolis, Minn.; John Day, Western Petroleum Refiners Association, Tulsa; R. L. Doan, Phillips Petroleum Co., Bartlesville, Okla.; Mr. and Mrs. F. H. Dunn, Wilcox Oil & Gas Co., Tulsa; H. A. Ells, Cities Service Oil Co., Bartlesville, Okla.; Paul Endacott, Phillips Petroleum Co., Bartlesville, Okla.

D. E. Fields, Tulsa Boiler & Machine Co., Tulsa; Cecil C. Forbes, Noble Drilling Co., Tulsa; M. E. Foster, Phillips Petroleum Co., Bartlesville, Okla.; Mr. and Mrs. Wirt Franklin, Ardmore, Okla.; Mrs. J. L. Fuqua, E. H. Moore Co.; Rush Greenslade, Gulf Oil Corp.; H. N. Greis, Deep Rock Oil Corp., Tulsa.

C. F. Guidinger, Standish Pipe Line Co., Bartlesville, Okla.; H. B. Gutelius, United Supply and Manufacturing Co., Tulsa; E. I. Hanlon, Hanlon-Buchanan, Inc., Tulsa; E. W. Harwell, Jones and Laughlin Steel Co., Memphis, Tenn.; D. G. Hefley, Dowell Inc.; Wm. Heldmar, Oil Well Supply Co.; Buck Herrick, Missouri Portland Cement Co., Tulsa.

A. N. Horne, Cities Service Oil Co., Bartles-

ville, Okla.; D. E. Horrigan, Papoose Oil Co.; Jack Howell, Filmcraft Productions; Mr. and Mrs. N. M. Hulings, First National Bank; D. K. Hutchcraft, Clark Bros. Co.; Dana H. Kelsey, Sinclair Prairie Co.; Art J. Kerr, Pittsburgh Equitable Meter Co., Tulsa.

Mr. and Mrs. M. J. Kirwin, Cities Service Oil Co., Bartlesville, Okla.; E. Koehler, Alco Products Co., Tulsa; Mr. and Mrs. A. E. Landsittel, Globe Oil & Refining Co., Wichita, Kans.; P. C. Lauinger, The Oil and Gas Journal, Tulsa; T. S. Loffland, Loffland Bros., Tulsa; D. E. Lounsbery, Phillips Petroleum Co., Bartlesville, Okla.

J. E. Mabee, Mabee Oil & Gas Co.; John Martin; Villard Martin, attorney, of Tulsa, and Mrs. J. H. Massie, Dallas, Tex.

H. S. McClintock, Sunray Oil Co.; Mr. and Mrs. R. Otis McClintock, First National Bank & Trust Co.; L. F. McCollum, Carter Oil Co.; J. E. McFate, Republic Steel Co.; J. F. McManmon, National Bank of Tulsa; Mr. and Mrs. E. H. Moore, E. H. Moore Co., Tulsa.

O. E. Morgan, General Machine & Supply, Wichita Falls, Tex.; M. J. Mullally, Tret-O-Lite Sales, Tulsa; C. R. Musgrave, Phillips Petroleum Co., Bartlesville, Okla.; G. G. Oberfell, Phillips Petroleum Co., Bartlesville, Okla.

C. H. Pape, Selby Oil & Gas Co.; R. F. Pielsticker, Skelly Oil Co.; George W. Probst, Clark Bros. Co.; H. L. Putnam, National Supply Co., all of Tulsa; R. P. Reid, Foster Petroleum Co., Bartlesville, Okla.; A. H. Riney, Phillips Petroleum Co., Bartlesville, Okla.

W. A. Rooney, Continental Can Co.; C. S. Sanders, Stanolind Oil & Gas Co.; W. G. Selby, Selby Oil & Gas Co.; Mr. and Mrs. J. L. Shakely, Frick-Reid Supply Co., R. D. Shaw, Dowell, Inc.; J. L. Shoemaker, Stanolind Pipe Line Co.; B. P. Sibole, Stanolind Pipe Line Co.; C. S. Simon, Midwest Piping & Supply Co.; H. D. Skyrm, General American Trans. Co., Tulsa.

George F. Smith, Continental Oil Co., Ponca City, Okla.; R. M. Smith, Cardwell Manufacturing Co., Wichita, Kans.; Mr. and Mrs. W. D. Smith, Worthington Pump & Machinery Co., Tulsa; Mr. and Mrs. F. J. Spang, Spang & Co., Butler, Pa.; C. F. Spangler, Visco Co., Houston, Tex.; C. O. Stark, Phillips Petroleum Co., Bartlesville, Okla.; J. F. Stephens, Gustin-Bacon Manufacturing Co., Kansas City, Mo.

J. S. Sterling, Stanolind Pipe Line Co.; C. H. Sweet, National Bank of Tulsa; Elmo Thompson, Superior Oil Corp.; J. W. Vaiden, Skelly Oil Co.; L. G. Valdes, Le Roi Engine Co.; Mr. and Mrs. B. W. Vinson, Vinson Supply Co., Tulsa; C. R. Wagner, Pure Oil Co., Chicago; Mr. and Mrs. Howe Walker, Hughes Tool Co., Tulsa.

F. P. Walter; George W. Walton, Unit Rig & Equipment Co.; Mr. and Mrs. W. K. Warren, Warren Petroleum Co.; W. B. Way, International Petroleum Exposition; Charles Wheatley, Wheatley Bros.; Carl White, Jr., Franks Manufacturing Corp.; Harold J. Whitehill, Whitehill Oil Corp.; C. O. Willson, The Oil and Gas Journal; Guy Woodward, Stanolind Oil & Gas Co., Tulsa.

(Continued on Page 78)

Among those boarding The Oil and Gas Journal special train at Chicago were: Upper left, B. H. Markham and J. H. Bivins, American Petroleum Industries Committee, director and attorney, respectively, of New York City, greet P. R. Applegate, president, Northern Group Pipe Lines, New York. Upper right: R. E. Hendrickson, sales manager and W. H. Pape, vice president, Crane & Co., Chicago. Lower left: Standard Oil Co. party from Cleveland, Ohio, consisting of A. Kidd, Dr. R. E. Burk, Mr. McDonald, and E. B. McConnell. Center left: S. J. McGiveran and J. F. Adams, sales manager, Owens Illinois Glass Co., Cleveland, Ohio. Center right: C. L. Marner, E. N. Gosselin, president, and J. E. Swanson, all of Graver Tank & Manufacturing Co., Chicago. Lower right: J. R. Sloan, Oil Trading Co., and R. A. Ludlow, secretary of the A.P.I. lubricating oil committee, both of New York

Digests of A. P. I. Papers

Abstracts of technical papers presented at annual meeting of American Petroleum Institute, San Francisco, Calif., November 3-7

New Lubricating-Oil-Decolorizing And Clay-Reactivating Process

By W. B. CHENAULT and A. E. MILLER (Sinclair Refining Co.)

THE clay treatment of lubricating-oil stocks consists of a coordinated series of continuous operations whereby oils are decolorized and the used clay reactivated to high efficiency by extraction with solvents.

Oil is contacted with the clay in the presence of naphtha and traces of acetone at temperatures high enough to utilize the clay efficiently and to insure removal of the naphtha and acetone, but not high enough to affect adversely the nature of the coloring matter adsorbed in the clay so that its reactivation with solvents becomes difficult or impossible.

The process yields finished oils meeting flash, color and viscosity specifications without further processing. The clay is handled, in the form of a slurry or cake with oil or naphtha, in the various steps of this process.

The complete process is a closed system, and a flue-gas atmosphere is provided during operations and in certain pieces of equipment to avoid incidental oxidation and danger of explosion or fire.

The process handles all grades of stocks, and the change-over from one stock to another is simple. The process as now carried out has been in commercial operation since June 1940, resulting in substantial savings in clay-treating costs.

Reduction of Hole Size in Drilling As Affecting Costs, Completion, And Production Practice

By I. W. ALCORN (Pure Oil Co.) and J. U. TEAGUE (Hogg Oil Co.)

THIS paper is an approach to the problem of how the reduction in hole size in drilling affects the cost and the completion and production practices. The authors point out that this is only a start and that more work should be done on the matter. The paper represents a joint effort of the southwestern district topical committees on drilling and production practices.

The data submitted on some 2,300 wells from all sections of the country indicate a trend toward the drilling of smaller-diameter holes, both exploratory and proven, and completing wells with smaller casing. Substantial savings are being realized in initial well costs by this practice.

No particular difficulty has been reported in drilling, completing, or producing the small-diameter wells. Nearly all the fields on which data were obtained are in the flowing stage; therefore, little information is available on artificial-lift installations in the small-diameter wells. But the predictions are that no trouble will be experienced with artificial-lift equipment in the small-diameter wells, except when a large volume of fluid will have to be produced with rod pumps.

Small-diameter wells can be repaired by all commonly used methods as easily and cheaply as large-diameter wells, except when the well is to be deepened or sidetracked. Then the small-diameter well is at a disadvantage.

The great majority of the small-diameter wells were completed with 5½-in. o.d. casing, which is considered by the majority of those who submitted data to be the smallest practical casing size. The popular size hole to drill for setting 5½-in. o.d. casing seems to be 8¾-in. A 9⅞-in. hole was drilled for the majority of the large-diameter wells reported and 7-in. o.d. casing was set as a final casing string.

The trend toward the drilling of smaller holes and setting smaller casing probably will continue because of the lower initial well cost, long expected flowing life of most fields, and the low rates of production on individual wells under enforced curtailment of production.

Oil-Field Transportation and Especially Developed Equipment

By S. H. GRINNELL (Union Oil Co. of California)

FOR the purposes of this paper, drilling and servicing equipment is divided into two classes: (1) Portable equipment, defined as "that equipment which is moved daily on the highway, and which conforms to all state, county and city laws," and (2) mobile equipment, defined as "that equipment which is moved every 2 or 3 weeks, and which conforms to all state, county and city laws and requires permits if moved on the highway."

Transportation in California is limited by the physiography. Dimensions as to size of units into which mobile equipment can be divided for long distance hauls are roughly: 15 ft. high, 11 ft. wide and 50 ft. long. Practically all drilling equipment is of the mobile type and, being moved from one geographical location to another in the state, it is so designed that it can be broken down in size so that it can be moved readily by trucks or shipped by rail. When in use in a field, the smaller units are assembled in a master unit which requires a permit to move and also requires special transportation equipment.

Moving of 136-ft. or 178-ft. derricks is accomplished by putting track-laying wheels or rubber-tired dollies under the derrick and towing it with a truck or tractor. A three-point support of the derrick is used to obtain stability while moving. Cost of moving a derrick ranges from $500 for 2,500 ft. in 12 hours to $1,000 for 3 miles in about 32 hours.

Draw works, drilling engine and foundation are moved as a second unit the costs for a move ranging from $75 to $150 for equipment capable of drilling to 15,000 ft. and weighing 53 tons.

Boilers complete with fittings weigh about 30 tons and are loaded on low-bed trailers by a pair of cranes. The boilers set on special subbases which automatically space them. Water pumps, gas and water controls, water heater and electrical generator are mounted on skids making a 15-ton unit. Average cost of moving a boiler plant is $150.

Cement is carried to the location in special tanks on semitrailers; capacity of the tanks varies from 400 to 600 sacks.

Servicing equipment must be portable and it is limited to a gross weight of about 68,000 lb., 18,000 lb. per axle, and a width of 8 ft. and a height of 13 ft. 6 in. For deeper wells, two types of portable servicing units are used, one mounted on a trailer and the other on a truck. Each has its own 90-ft. telescoping derrick which is raised by the unit; capacity of one unit is 300,000 lb. and the other 200,000 lb.

Precise Commercial Fractionation In 1,000-Bbl. Stedman Unit

By L. B. BRAGG (Foster-Wheeler Corp., New York), and F. MORTON (Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I.)

THE paper describes the design and operation of a commercial fractionation unit (1,000 bbl. per day) utilizing Stedman packing.

Full details of the design are given, with flow sheet and photographs. Three different types of operation are described:

A. Fractionation of a straightrun gasoline into seven narrow-boiling fractions, a composite slop fraction, and a still residue. Two of these fractions which contain, respectively, substantially pure *n*-hexane and *n*-heptane and the residue may be isomerized, cyclized, or reformed. The other fractions, containing substantially all the isoparaffins, naphthenes, and aromatics, and the *n*-pentane may be variously reblended to give high-octane-rating complementary fractions suitable for blending with isooctane or alkylates to give 100-octane aviation fuels.

B. Fractionation of special cuts — the example given being the production of a concentrate of isomeric hexanes from a low-octane gasoline, the fraction so obtained having a leaded octane rating of greater than 100.

C. Fractionation of a narrow-boiling sidestream from conventional topping unit (boiling range, 210° to 250° F.) to give substantially pure toluene.

Brief mention is made of the efficiency, holdup, friction loss, etc., of the packing—full details of which will be published at a later date. The boiling ranges and properties of tank samples are included.

The paper is presented under the joint sponsorship of the Foster Wheeler Corp., New York, N. Y., and Trinidad Leaseholds, Ltd., Pointe-a Pierre, Trinidad, British West Indies, the unit having been erected and tested at the latter's refinery in Trinidad.

The Synthesis and Properties Of Hydrocarbons of High Molecular Weight

By J. N. COSBY and L. H. SUTHERLAND (Pennsylvania State College, State College, Pa.)

THIS paper is a summary of the first 16 months' work on American Petroleum Institute Research Project 42, on the synthesis and properties of hydrocarbons of high molecular weight, at Pennsylvania State College. The synthesis of these hydrocarbons had as objectives the obtaining of data:

1. To permit conclusions on the effect of chemi-

cal structure on physical properties in the higher-molecular-weight ranges.

2. To furnish data on hydrocarbons of high molecular weight of value in identification of hydrocarbons or hydrocarbon mixtures isolated from petroleum.

3. To afford data useful in chemical-engineering calculations on petroleum fractions above gasoline.

4. To provide the industry with reliable methods of preparation and purification of hydrocarbons of high molecular weight which will be useful guides when the need arises for preparing larger quantities of such hydrocarbons.

Twenty-two hydrocarbons ranging in molecular weight from 344 to 450 have been prepared, with a purity of 95 per cent or better. The following physical properties have been determined on each of these hydrocarbons.

1. Kinematic viscosity at 68°, 100°, 140° and 210° F.

2. Kinematic viscosity index by the Dean and Davis method.

3. Density at 68°, 100°, 140° and 210° F.; gravity, in degrees A.P.I., calculated.

4. Melting point taken from melting curve.

5. Boiling points from vapor-pressure curve over the range 0.5 mm. to 5.0 mm.

6. Heat of vaporization, calculated for the range 0.5 to 5.0-mm. pressure.

7. Refractive index at 20°, 30° and 40° C.

8. Specific refraction, calculated at 20° C.

9. Mean and specific dispersion at 20° C. Measurements of other physical properties are in progress.

Several generalizations have been pointed out in the relation of physical properties to structure. Application of the data presented in this paper has been made in checking the work of Kurtz on molecular volume.

Closer Association Between the Producing Engineer and His Operating Coworker

By D. R. KNOWLTON (Phillips Petroleum Co.)

THE development of petroleum engineering as a distinct and independent profession is discussed. The principal types of administrative organizations in general use by the oil companies are briefly explained. It is stated that the effectiveness of the association between a production engineer and any operating coworker is in some degree directly proportional to the mutual respect and confidence which exist between them. By the selection and proper development of capable men for the jobs, by definitely instructing them as to their responsibility and authority, and by requiring joint and concerted action by them, the association of the production engineer and his operating coworker will be more harmonious, more efficient and more profitable.

●

Oil Men Laud Journal's Trains

(Continued from Page 76)

M. P. Youker, Phillips Petroleum Co., Bartlesville, Okla.; H. E. Zoller, Derby Oil Co., Wichita, Kans.

Chicago Train Reservations

Joe Adams, Owens Illinois Glass Co., Cleveland, Ohio; Mr. and Mrs. P. R. Applegate, Northern Group Pipe Lines, New York; H. T. Ashton, Socony-Vacuum Oil Co., Inc., St. Louis, Mo.; Mr. and Mrs. C. R. Athy, Columbus, Ohio; Mr. and Mrs. W. E. Beatty, Standard Oil Co., Cleveland, Ohio; J. H. Bivins, American Petroleum Industries Committee; Robert Blake, Shand & Jurs, Chicago.

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R. A. Ludlow, American Petroleum Institute, New York; Mr. and Mrs. B. H. Markham, American Petroleum Industries Committee, New York; C. L. Marner, Graver Tank & Manufacturing Co., East Chicago, Ind.; Mr. and Mrs. J. H. McCabe, E. W. Saybolt Co., New York; E. B. McConnell, Standard Oil Co. of Ohio, Cleveland, Ohio; W. F. McConnor, National Tube Co., Pittsburgh; Mr. McDonald, Standard Oil Co. of Ohio, Cleveland, Ohio; Mr. and Mrs. R. A. McIlroy, Pure Oil Co., Chicago.

A. W. McKinney, National Supply Co., Toledo, Ohio; Mr. and Mrs. W. H. Merritt, Cities Service Co., Chicago; Joseph Moller, Pure Oil Co., Chicago; Harry Moreland, Great Lakes Pipe Line Co., Kansas City, Mo.; Mr. and Mrs. S. E. Murphy, Cities Service Oil Co., New York; H. K. Nieuwenhuis, Shell Oil Co., Inc., New York.

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W. R. Boyd, Jr., president of the American Petroleum Institute, and Mrs. Boyd, are met at the station upon the arrival of the special train, with rickshas, pulled by Chinese boys

Characteristics of California Crude Oils

By R. C. MITHOFF, G. R. MacPHERSON, and F. SIPOS
Standard Oil Co. of California, San Francisco, Calif.

A. P. I.

ABSTRACT

Brief description is given herein of the crude-oil-analysis methods employed by the Standard Oil Co. of California. Based upon results of these analytical methods, California crude oils are compared with oils produced elsewhere in the United States. It is shown that the California crude oils are heavier, more viscous, substantially more naphthenic, of higher sulfur content, and of different boiling characteristics than are most Mid-Continent, Pennsylvania, and Texas crude oils. They also produce gasoline of substantially higher octane number. Description is given of the ways in which the refining requirements of California oils differ from those of eastern oils.

Paper presented before Division of Refining at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

R. C. MITHOFF

G. R. MacPHERSON

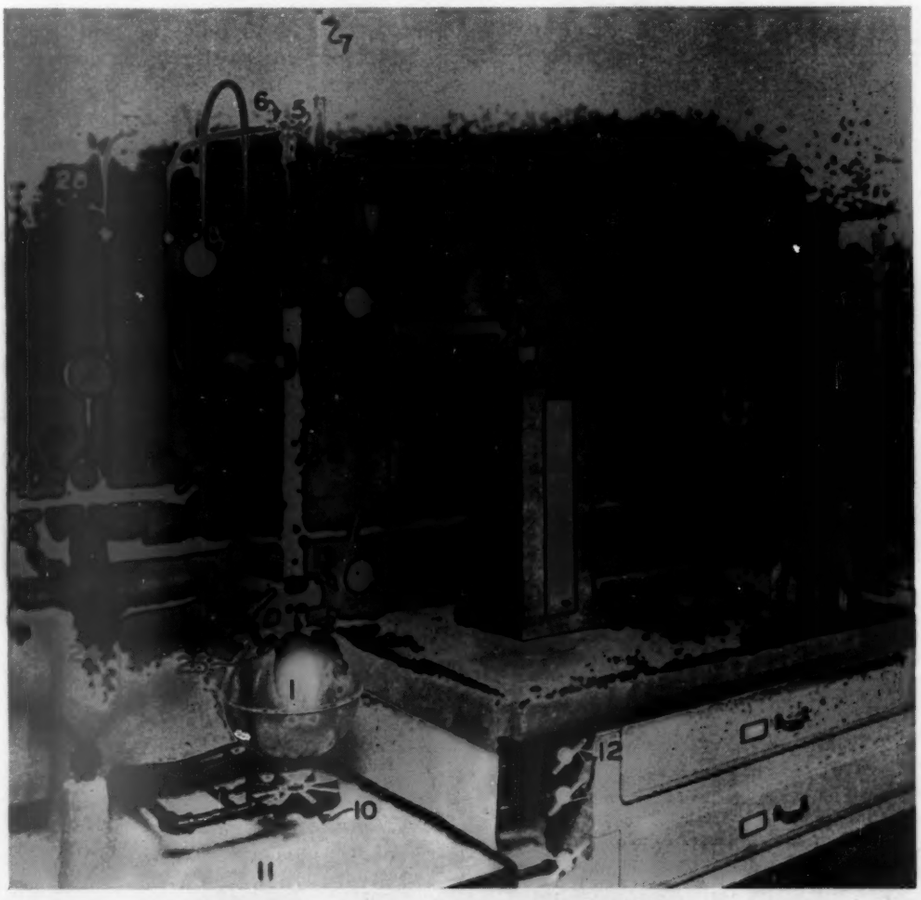
F. SIPOS

CALIFORNIA crude oils differ markedly from most other crude oils produced in the rest of the United States in gravity, paraffinicity, sulfur content, and asphalt content. They also differ markedly among themselves in these factors. These wide variations in crude-oil quality lead to the necessity that companies processing California stocks should place considerable emphasis on crude-oil analysis. They also lead to wide variation in the refining methods required. In this paper, crude-oil-analysis methods used by the Standard Oil Co. of California are described briefly, the different qualities of the California crude oils are compared with those of oils produced elsewhere in the United States, and a brief description is given of the differences in the required refining processes.

Methods for Analysis of Crude Oils

Crude oils produced in California differ in quality among themselves substantially more than is the case in the Mid-Continent and in the East. The state contains several hundred different pools and zones, each of which produces its own characteristic crude oil. These crudes range in gravity from approximately 6° to 60° A.P.I. Some contain essentially no gasoline, and others contain as much as 85 per cent of gasoline with a 390° F. end point. Other qualities vary equally widely.

This situation leads to the necessity of placing considerable emphasis upon procedures for analysis of crude oils, and upon the results therefrom. A brief description is given hereinafter of the main procedures for analysis of crude oils employed by the Standard Oil Co. of California.



1. Distillation flask (5,000-ml.)
2. 29-in. fractionating column
3. Column packing
4. Reflux condenser
5. Inlet air to reflux condenser
6. Air outlet to atmosphere
7. A.S.T.M. thermometer, 30° to 580° F.
8. Air-control valve
9. Steam-control valve to still
10. Burner, air-gas-mixture blow-type
11. Sand-filled safety catch pan
12. Controls for gas and air valves
13. A.S.T.M. thermometer, 30° to 760° F.
14. Condenser
15. Overhead rundown line
16. Gas-absorbing line
17. Receiver, 2,000-ml. capacity
18. Receiver holder (ice and water bath)
19. Gas vent line
20. Safety pressure release
21. Calcium chloride drier
22. After-condensers
23. Holders for after-condensers
24. Steam superheater
25. Flange support
26. Low-pressure steam valve
27. High-pressure steam valve
28. Water line for reflux condenser

Fig. 1—Distillation apparatus for crude analysis—5-liter still

Crude Analysis Methods "A," "B," and "D"

The equipment developed and used by Standard for making analyses by the methods designated "A," "B," and "D" is shown in Fig. 1. It consists of a 5-l. stainless-steel flask equipped with a 29-in. glass column made from 45-mm. pyrex-glass tubing. The column is filled to a depth of 18 in. with 4 mm. by 6-mm. glass nipples, and is fitted at the top with an internal reflux condenser. The column is protected against heat loss by a readily removable, 85 per cent magnesia insulating jacket. The distillate is condensed in an

ice-cooled stainless-steel condenser, and collected in an ice-cooled, stoppered, 2,000-ml. graduated cylinder. A vapor-recovery system is connected to the vent from the receiver. It consists of a calcium chloride drier and aftercondensers cooled with a slurry of solid carbon dioxide and chloroform.

The method of heating the flask is an important feature. A cast-iron star burner of the usual type used in hot plates is employed, except that the venturi section is replaced by tight connections to the gas and compressed-air supplies. The gas is discharged into the mixing section through the usual jet. This arrangement permits accurate and reproducible control of the height and temperature of the flame.

Safety features include use of a wire-inserted clear-glass safety shield in front of the still, a metal flask, a sand-filled catch pan below the flask, and a mercury-bubbler pressure relief on the line to the after-condenser.

About 4,000 ml. of crude oil is charged to the still by means of a siphon through the steam connection on the flask. It then is warmed gently for about 15 minutes or until the crude is dehydrated, and foaming and bumping have ceased. The flame then is regulated to produce net overhead at the rate of about 0.2 per cent of the volume of charge per minute. When the vapor line reaches 225° F., the insulation is put onto the column, and air admitted to the reflux condenser. The flame and air are regulated so that the distillation rate is maintained, and so that the column operates just slightly below the flooding stage.

A first cut, somewhat lighter than the lightest gasoline to be made, is collected and stored, with provision to prevent loss of light end. One per cent cuts then are collected in open graduated cylinders, until the end of the distillation. Superheated steam is introduced as a distillation aid when the still temperature reaches 550° to 625° F.

With heavy or wet crude oils it is sometimes necessary first to distill the crude oil in a larger metal still, without fractionation, to produce a wide blanket overhead cut, which later is redistilled in the previously described equipment.

The operating procedures for methods "A," "B," and "D" differ only in depth to which the crude oil is distilled. The stock is run so that the different cuts can be blended proportionately to produce the following stocks:

Method "A"

Gasoline of 390° F. end point.

Residuum following 390° F. end point gasoline.

Method "B"

Gasoline of 390° F. end point.

Kerosene distillate (400 Saybolt-Thermo viscosity) following 390° F. end point gasoline.

Residuum following the foregoing kerosene.

Method "D"

Three gasolines: end point, respectively, 340°, 390°, and 437° F.

Kerosene distillate (360 Saybolt-Thermo viscosity) following 340° F. end point gasoline.

Kerosene distillate (400 Saybolt-Thermo viscosity) following 390° F. end point gasoline.

Gas oil (viscosity, 40 sec. Saybolt Universal, at 100° F.) following 390° end point gasoline.

Residuum following 390° F. end point gasoline.

Residuum following 400-viscosity kerosene.

Residuum following 40-viscosity gas oil.

Appropriate inspections of each stock are obtained. The results are recorded in tabular form on a single sheet of paper, one crude oil to each sheet. These sheets are bound in loose-leaf books, which are revised and kept up to date as new data become available. Table 1 shows the results of a method "D" analysis of a typical crude oil from Long Beach field, California.

True-Boiling-Point Analysis

A schematic diagram of the equipment used by the Standard Oil Co. of California for true-boiling-point distillation of crude oils is shown in Fig. 2. The equipment consists essentially of a 2-liter glass flask attached to an electrically heated, vacuum-jacketed glass column packed with 32 in. of 8-mm. glass raschig rings. The over-all height of the still—including flask, expansion joint, column, reflex condenser, and thermocouple well—is about 61 in. The flask is heated with a bag-type electric heater. The auxiliary equipment includes a condenser, receiving system, and vacuum control equipment.

A chilled 1,500-ml. sample of the crude oil is

TABLE 1—METHOD "D" ANALYSIS OF TYPICAL CRUDE OIL FROM LONG BEACH FIELD, CALIFORNIA

		Gasolines				Kerosene distillate		Gas oil	Residuum after		
			390° F. end point								
	Dry crude	340° F. end point	Unrectified	Butane-free	437° F. end point	360-Viscosity (Saybolt-Thermo) after 340° F. end point	400-Viscosity (Saybolt-Thermo) after 390° F. end point	40-Viscosity (Saybolt Universal at 100° F. after 390° F. end point	390° F. end point gasoline	400-Viscosity kerosene distillate	40-Viscosity gas oil
Yield:											
Percentage net from crude as received	....	15.6	20.8	*20.8	25.5	14.4	7.2	31.2	79.2	72.0	48.0
Percentage from butane-free crude	....			*20.8							
Percentage range from crude	....	0-15.6	0-20.8	....	0-25.5	15.6-30.0	20.8-28.0	20.8-52.0	20.8-100.0	20.8-100.0	52.0-100.0
Butanes and lighter, per cent*	0.0	....	0.0	....	....	....	....	....	....	....	....
Gravity, °A.P.I.	25.1	57.2	53.8	....	51.1	40.1	38.9	32.7	19.3	17.7	11.6
Flash point:											
Tag. closed cup, °F.*	....	....	....	....	....	135	165	....	....	....	....
Pensky-Martens, °F.*	....	....	....	....	....	....	....	213	....	....	....
Cleveland open-cup, °F.	....	....	....	....	....	....	....	....	250	300	470
Viscosity:											
Saybolt-Thermo	....	....	....	....	....	355	395	....	....	....	....
Saybolt Universal at 35° F., sec.	1,030	....	....	....	....	....	....	....	....	....	....
Saybolt Universal at 70° F., sec.	247	....	....	....	....	....	....	45.3	....	....	....
Saybolt Universal at 100° F., sec.	121	....	....	....	....	....	....	39.0	724	....	....
Saybolt Universal at 130° F., sec.	....	....	....	....	....	....	....	....	301	541	....
Saybolt Universal at 210° F., sec.	....	....	....	....	....	....	....	....	69	93	777
Pour point, °F.	+15	....	....	....	....	....	....	+15	+45	+50	+85
Sulfur, per cent by weight	1.16	0.040	0.058	....	0.088	0.22	0.245	0.78	1.40	1.48	1.73
Wax (Holde), per cent	2.20	....	....	....	....	....	....	....	....	3.11	....
Water and sediment, per cent	0.20	....	....	....	....	....	....	....	....	....	....
Water by distillation, per cent	0.20	....	....	....	....	....	....	....	....	....	....
Reid vapor pressure, lb.	1.75	....	....	....	....	....	....	....	....	....	....
Saponification number	0.67	....	....	....	....	....	....	....	....	0.64	....
Conradson carbon residue, per cent	....	....	....	....	....	....	....	....	7.61	8.81	11.7
Delay centane number*	....	....	....	....	....	39.2	41	47	....	....	....
Neutralization number, mg. of potassium hydroxide per gram	....	....	....	....	....	....	0.30	0.57	....	....	....
Aniline point, °F.	....	....	....	....	....	....	136	146.5	....	....	....
Characterization gravity, °A.P.I.	....	....	....	....	....	....	....	....	....	27.2	....
Smoke tendency (lamp), mm.	....	....	....	....	....	32	33	....	....	....	....
Octane number, C.F.R. motor method:											
Clear	....	63.5	59.9	....	55.0	....	....	....	....	....	....
Plus 1.0 ml. TEL† per gal.	....	....	69.0	....	....	....	....	....	....	....	....
Plus 2.0 ml. TEL† per gal.	....	....	73.5	....	....	....	....	....	....	....	....
Natural gasoline to obtain 170° at 20 per cent point*	....	....	30.4	....	....	....	....	....	....	....	....
Octane number after natural-gasoline blending*	....	....	64.5	....	....	....	....	....	....	....	....
Average boiling point	....	243	271	....	300	413	431	552	....	....	....
	D-158	D-86	D-86	....	D-86	D-86	D-86	D-158	....	....	....
A.S.T.M. Distillation, in °F.:											
Initial boiling point	140	126	133	....	142	356	398	432	....	....	....
5 per cent point	260	173	183	....	188	367	407	470	....	....	....
10 per cent point	300	190	202	....	210	377	412	478	....	....	....
20 per cent point	416	209	226	....	238	386	418	492	....	....	....
30 per cent point	516	223	244	....	260	394	421	508	....	....	....
40 per cent point	599	234	258	....	271	401	425	526	....	....	....
50 per cent point	....	244	273	....	299	409	428	545	....	....	....
60 per cent point	....	255	289	....	319	419	433	571	....	....	....
70 per cent point	....	265	303	....	342	429	438	591	....	....	....
80 per cent point	....	281	324	....	372	441	445	612	....	....	....
90 per cent point	....	293	343	....	399	457	456	644	....	....	....
95 per cent point	....	310	363	....	422	472	468	658	....	....	....
End point	625	340	390	....	437	483	477	680	....	....	....
Recovery, per cent	44.5	99.0	99.0	....	99.0	98.0	99.0	99.0	....	....	....
Loss, per cent	....	0.0	0.0	....	0.0	....	....	....	....	....	....

*Estimated. †Tetraethyl lead.

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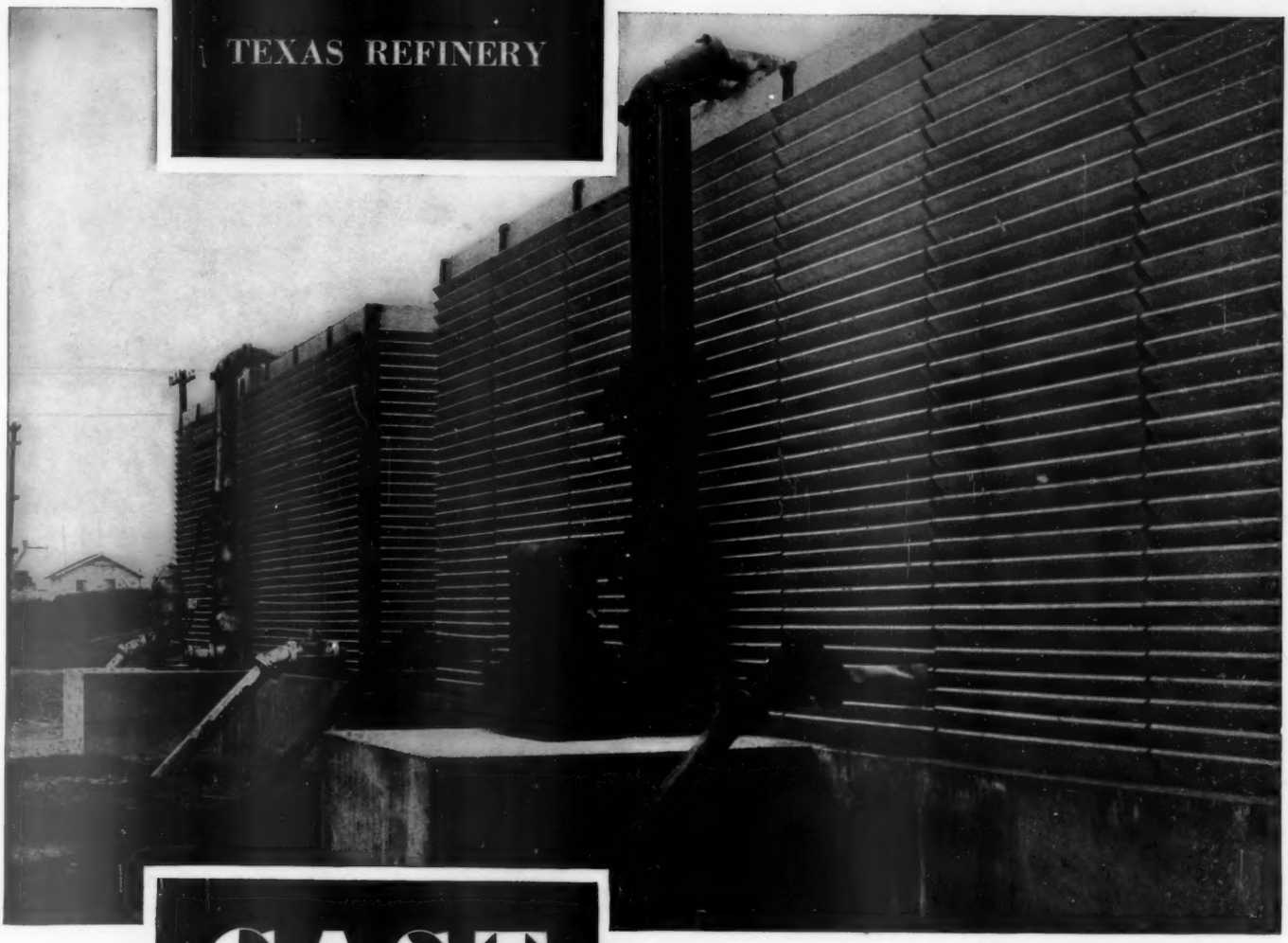

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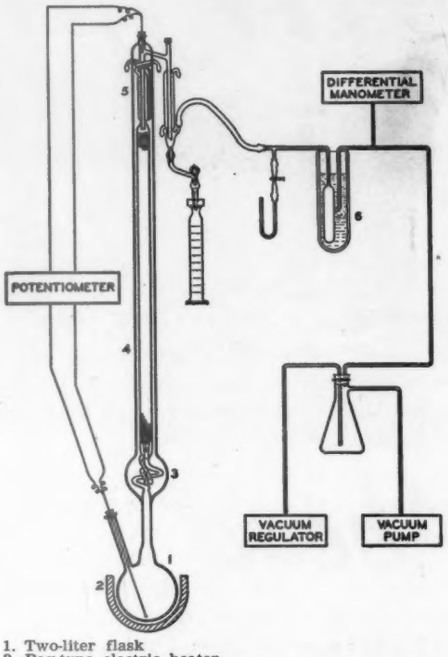
charged to the flask and distilled at a reflux ratio of approximately 8 to 1—producing about 1.5 ml of net overhead per minute. The temperature of the still and vapor line is recorded at times corresponding to each 2 per cent overhead. Cuts corresponding to each 4 per cent from still charge are collected separately.

The distillation is performed at atmospheric pressure, until the still temperature reaches 635° F. The still then is cooled, evacuated to 10-mm. pressure, and again run to 635° F. still temperature. The still is cooled, and the contents transferred to the still (shown in Fig. 3) which has a shorter column. This still is evacuated to about 1-mm. pressure, and run to 635° F. still temperature as before. In the case of lean or heavy crude oils, the stock sometimes is charged directly to the still shown in Fig. 3, and the entire distillation performed therein.



1. Two-liter flask
2. Bag-type electric heater
3. Thermal-expansion joint
4. Electrically heated, vacuum-jacketed column, 28-mm. i.d.
5. Internal reflux condenser
6. Carbon dioxide-chloroform after-condenser.

Fig. 2—Apparatus for true-boiling distillation

On the appropriate 4 per cent cuts, the following tests are obtained:

1. Gravity.
2. Kinematic viscosity at two or three temperatures.
3. Sulfur.
4. Neutralization number.
5. Pour point.
6. Aniline point.
7. Molecular weight (from gravity and boiling point).

Neither A.S.T.M. distillations nor octane numbers are obtained on the cuts from the true-boiling distillation.

The data from the true-boiling distillation are of considerable value when used in conjunction with results of method "D" analysis to estimate the yield and quality of distillates other than those shown in the "D" method. It is, therefore, the practice in the Standard company to correlate the results of true-boiling distillations and method "D" analyses on each crude oil on which both sets of data are obtained, and to prepare a separate report and set of charts for each of such crude oils.

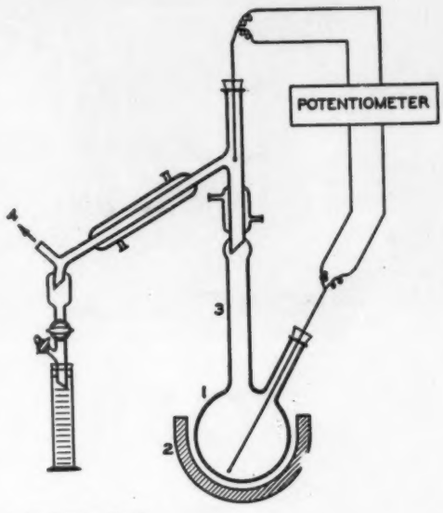
Table 2 shows the results of a true-boiling-point distillation of a typical crude oil from the Long Beach field, California.

Characterization Gravity

The characterization gravity is a test developed several years ago by Standard to measure the paraffinicity of heavy oils. It serves essentially the same purpose as does the U.O.P. characterization factor "K," except that it is susceptible of more accurate measurement. The characterization gravity also affords a somewhat more accurate means of estimating the octane number of gasoline made by cracking heavy residuums than does the U.O.P. "K."

The characterization gravity is the arithmetic average of the instantaneous gravities of the distillate boiling at 350°, 450°, and 550° F. vapor-line temperature at 25 mm. pressure in a true-boiling-point distillation. It may be calculated from any true-boiling-point distillation by means of a Cox chart, provided the true-boiling-point distillation is carried far enough. It often is determined also on heavy residuums by the performing of a spe-

(Continued on Page 187)



1. Two-liter flask
2. Bag-type electric heater
3. Insulated open column (Vigreaux type), 28-mm. i.d. × 254 mm.
4. Connection to vacuum system.

Fig. 3—Modified true-boiling apparatus for heavy residuum

TABLE 2—TRUE-BOILING-POINT DISTILLATION OF TYPICAL CRUDE OIL FROM LONG BEACH FIELD, CALIFORNIA
Gravity of crude oil—25.1° A.P.I.

Distillation data						Inspection of cuts											
							Viscosity										
							Kinematic (centistokes)			Saybolt Univ. (sec.)							
Vapor temperature (°F.)	Volume distilled based on crude (per cent)	Pressure (millimeters of mercury, absolute)	Temperature, converted to 760-mm. pressure (°F.)	Midpoint (per cent distilled)	Vapor temperature at midpoint per cent distilled (°F.)	Gravity (°A.P.I.)	100° F.	130° F.	210° F.	100° F.	130° F.	210° F.	Saybolt-Thermo*	Sulfur (per cent by weight)	Neutralization No. (milligrams of potassium hydroxide per gram of oil)	Pour point (°F.)	Aniline point (°F.)	Molecular weight
143	2		143														
166	4		166	2	143												
190	6		190														
240	8		240	6	190	56.6	0.65	0.56	0.42					0.010				†100
260	10		260															
281	12	754	281	10	260	53.8									0.142	Below—70	124	
305	14		305															
327	16		327	14	305	48.4	0.88	0.74	0.51				188	0.066				†127
354	18		354															
380	20		380	18	354	44.1									0.154	Below—70	125	130
406	22		406															†157
428	24		428	22	406	40.5	1.46	1.16	0.73				333	0.19				
205	26		430															
218	28		447	26	430	37.0									0.257	—65	134	
238	30		474															†179
260	32		503	30	474	35.7	2.34	1.76	1.01	33.9			553	0.40				
276	34	10	523												0.628	—15	142	
300	36		555	34	523	32.9												†211
320	40		579	38		32.5	4.74	3.22	1.56	41.5	36.8			0.79				
328	42		590												0.995	+15	159	
340	44		604	42	590	31.4												†282
328	47		705															
327	49		704	47	705	26.6	14.53	8.27	2.90	75.4	53.0	36.2		1.19				
346	51	0.85	730												1.015	+60	159	
363	53		753	51	730	24.8												308
374	55		768															
386	57		776	55	768	23.3	35.0	17.10	4.83	163.2	85.7	42.0		1.25				
439	59		841												1.225	+80	169	†380
452	61	1.05	861	59	841	21.9												
479	63		897												1.210			†410
492	65		912	63	897	19.8	162	59.3	10.53	747	275	61.0		1.33				
523	67		955	66	933	19.1				†1,350	447	74.9					172	
Bottoms	33					8.3	[Flash point (Cleveland), 565° F.]					6,600		1.97		+110	(Conradson carbon residue 15.36 per cent)	

*Converted from kinematic viscosity at 100° F.
†Esimated.

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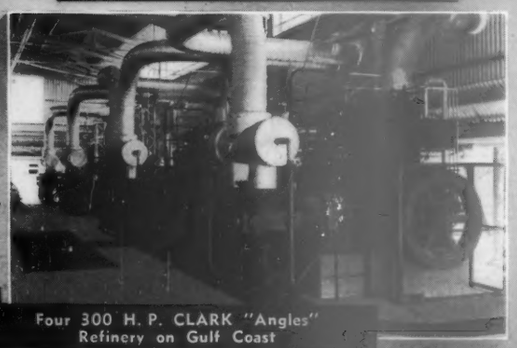

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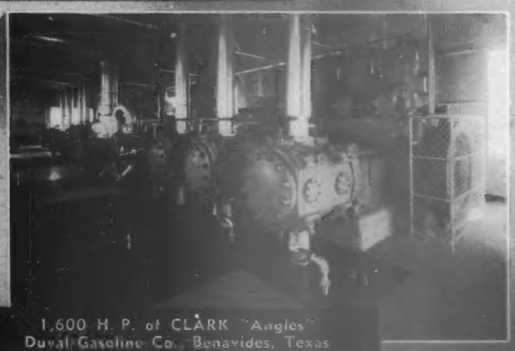
Refinery on Gulf Coast



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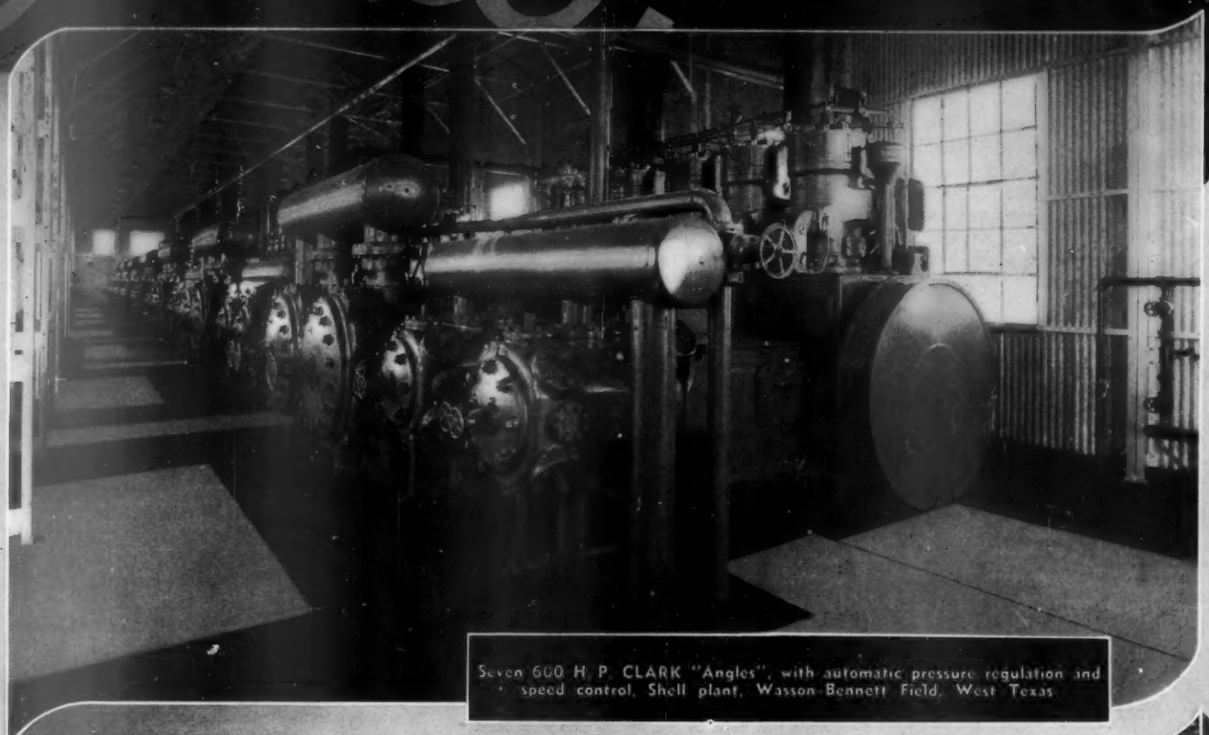

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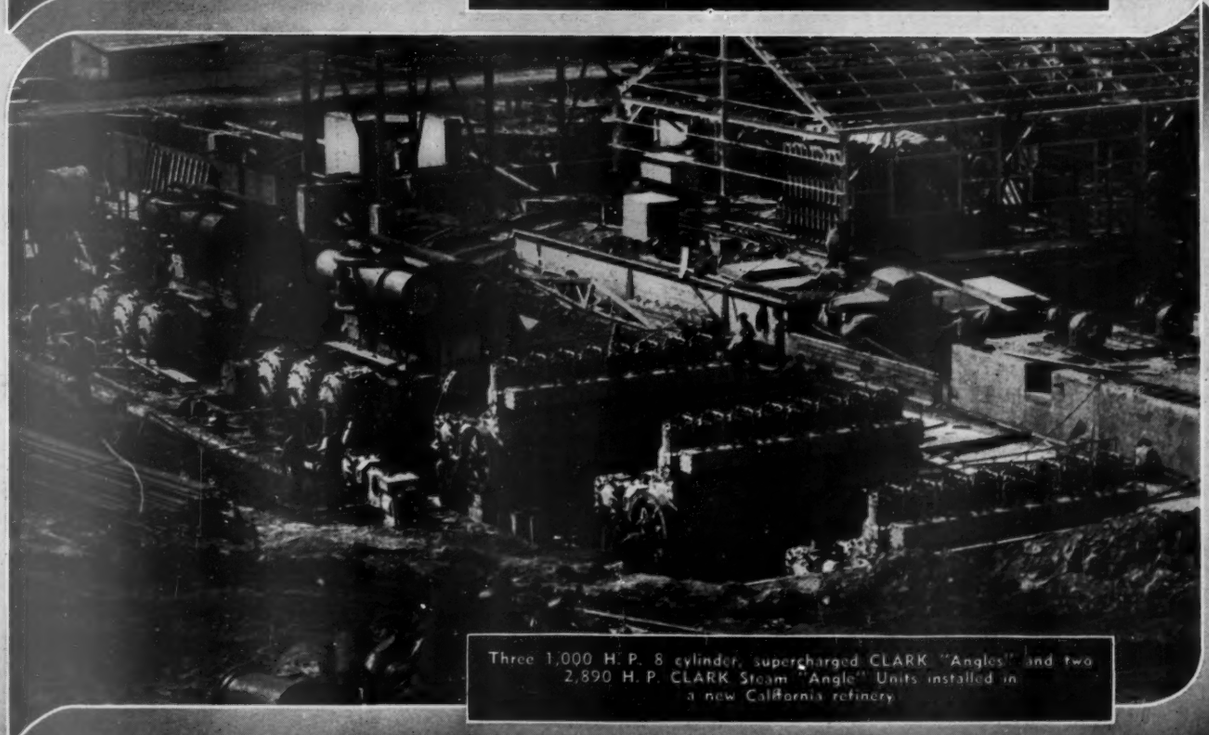

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A Review of Multiple-Zone Production in California

By ROBERT F. CORY
Texas Co. of California, Long Beach, Calif.

A. P. I.

ABSTRACT

A multiple-zone well is one which does the work of two or more single-zone wells, keeping the production from each zone under separate control. Zones should be kept separate because of varying conditions between them. Multiple-zone wells are used when space is limited, when high potentials per well are important, when most of the recovery will be by natural flow, or when one zone can be used to gas-lift oil from another zone. A two-zone well is to be preferred to a three-zone well, as the two-zone well is less complex, and hence offers less possibility for trouble.

The chief problem in drilling and completing a multiple-zone well is cementing the pipe between zones. The production problems are more serious. Packers are likely to give trouble. Sand production can cause serious trouble. Repairs are generally difficult and expensive.

The principal use of multiple-zone wells in California has been in the Wilmington and West Montebello fields. The results have been satisfactory, but California practice indicates that, in general, single-zone wells are to be preferred to multiple-zone wells.

Paper presented before Division of Production at the annual meeting of the American Petroleum Institute, San Francisco, Calif., Nov. 3-7, 1941.

IN this paper a zone is defined as a section or interval which, through custom, has been produced as a unit; and a multiple-zone well is defined as one which does the work of two or more individual-zone wells. A multiple-zone well differs from a well merely open to several zones in that the production from each zone can be controlled separately. The wells included in this definition may provide separate passages from the zones to the surface, allowing surface control of production; or the production from each zone may be determined by subsurface control such as side-door chokes, bottom-hole chokes, or similar methods. In the latter case the production is mixed before reaching the surface, but the amount from each zone is under complex control. Typical multiple-zone wells are shown in Fig. 1.

When several productive zones exist, the method of producing the oil and gas from them to give

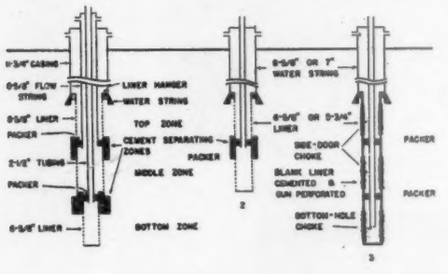


Fig. 1

the maximum profit must be selected. Due to competition, reduced value of deferred income, interest, and taxes, producing from only one of the zones by all wells is not feasible. This leaves the following methods for consideration:

1. Producing several zones together in each well.
2. Producing several zones separately in each well.
3. Producing each zone by separate wells.

Under California practice, for curtailment purposes, a multiple-zone well is considered no different from a single-zone well. For this reason, combined with the mechanical difficulties involved in pumping two or more zones simultaneously, multiple-zone wells practically have been restricted to areas where production is by natural flow.

The special conditions required to make a multiple-zone well profitable occur, therefore, only in the early development of a field. In any case, varying conditions will justify different methods, even in the same field.

Advantages of Separating Zones

Separation of several zones should be maintained either by separate wells to each zone or by multiple-zone wells. If several zones are open in one well without separation, the pressure differences between several zones may result in forcing oil from the high-pressure zone into the low-pressure zones. This may mean either rendering large volumes of oil and gas unrecoverable, or in many cases it is a direct gift to competitors. Fig. 2, showing conditions in the Wilmington field, illustrates this possibility.

Under curtailment, when a well produces several zones separately, all zones may be used to establish the potential; and then the allotment can be produced from the zones yielding the most valuable oil. Or, if the volume of gas produced is the basis for curtailment, as is the case in the West Montebello field, the zone with the lowest gas-oil ratio may be produced alone after the potential has been established. If the various zones on a lease are produced by separate wells, when conditions permit, for economic or mechanical reasons, a few wells may produce the allowable for the lease.

By isolating the various zones the advance of edge water can be controlled, and the flooding of a lower zone can be avoided when an upper zone goes wet. Separating wet zones from zones producing clean oil also reduces the cost of dehydrating the oil, because a smaller volume of fluid has to be treated.

When production of sand is a problem, isolating the various zones allows accurate control of the production rate from each zone, a condition not possible when several zones are open together. In many cases the production of sand can be prevented, if the troublesome zone is produced in the proper manner and at the proper rate.

Comparison of Multiple-Zone Wells and Multiple Wells

Limited space and prevailing conditions have been the principal incentive for multiple-zone completions. If a portion of a field has been divided into town lots, it usually results in many small leases and many different operators. Also, the well spacing may be limited by law. Multiple-zone wells were developed to satisfy offset requirements and to meet competition under these conditions. Multiple-zone wells have been used also when space has been limited by buildings or other conditions.

Under competitive conditions, the recovery to be expected from a multiple-zone well will be greater than from a single-zone well, but will be less per zone. The relative values of the differences in production, compared with the costs of obtaining the production differences, usually should be the determining factor. In the Wilmington field the cost of a two-zone well is approximately 10 per cent more than of a single-zone well. The three-zone wells cost 30 to 50 per cent more than a single-zone well.

In wells with high formation pressure, high gas-oil ratios, and low productivity indices, most of the production should be by natural flow. The

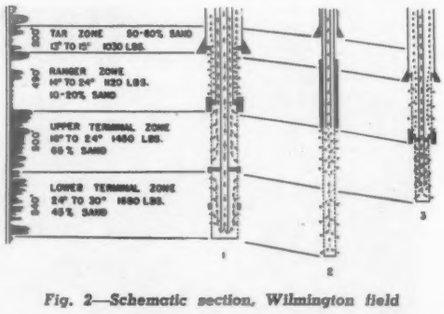
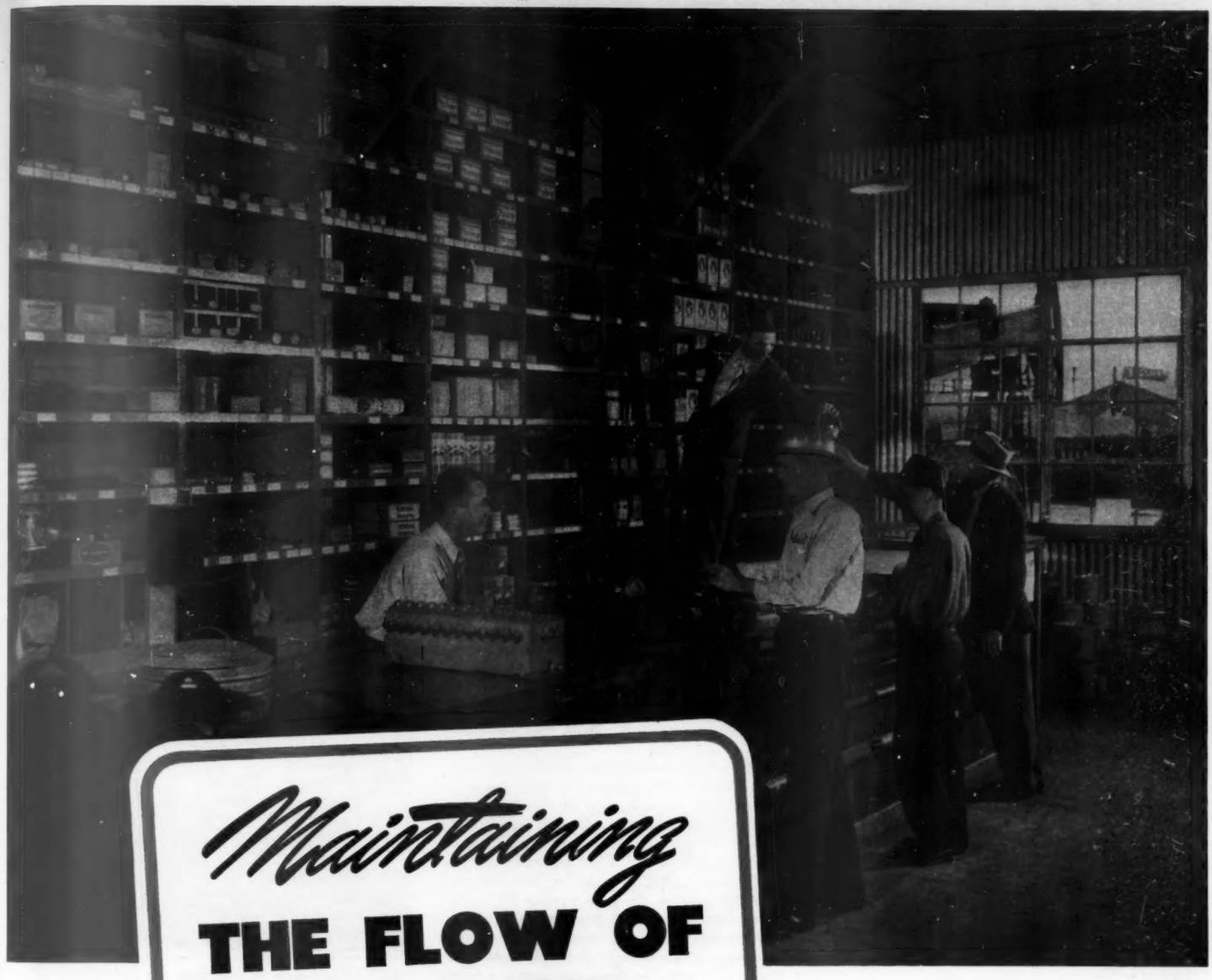


Fig. 2—Schematic section, Wilmington field

deeper the well, the higher the probable percentage of the profitable oil that will be recovered by natural flow, and the greater the additional recovery required from each zone to pay for the difference in cost between one multiple-zone well and equivalent wells with a separate well to each zone. This is especially true when repressuring operations are being carried on.

One of the chief disadvantages of the multiple-zone well is its complexity, which results in increased problems and troubles. Sand production is much more serious, as there are more passages to be clogged with sand; moreover production is over packers. Sand blasting can result in unrestricted communication between zones. In one case a string of tubing had a hole sand-blasted in it in 3 hours. Also, sand-cleanout jobs assume major proportions when one or more sanded



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packers must be pulled and an occasional flow string washed over.

Pumping a multiple-zone well is a serious problem, unless only one zone is produced at a time. To pump one zone while another zone is flowing requires that all the gas and oil produced from the zone being pumped must go through the pump. This is difficult—if not impossible—due to gas-locking the pump, unless the gas-oil ratio is extremely low. Pumping two zones separately at the same time has been done, but the conditions required are very rare. Because of the many possibilities for trouble, the practice is not recommended. When a multiple-zone well is considered a single well, most of its advantages are lost unless the zones can be produced simultaneously. For this reason it is probable that most multiple-

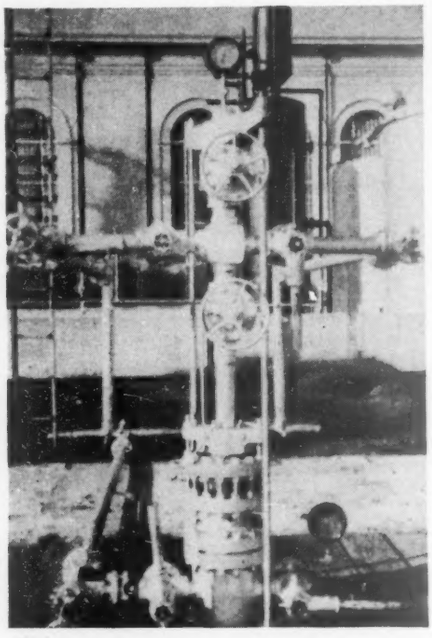

Fig. 3—A two-zone tree

zone wells either will be pumped with several zones open without separation, or they will be made single-zone wells at the end of their flowing life.

Curtailment may be the determining factor in deciding for a multiple-zone well. The additional cost of the multiple-zone well may be more than offset by the value of the additional allowable. An additional 10 per cent in the drilling cost may result in increasing the allowable more than 30 per cent.

The use of bottom-hole chokes and side-door chokes allows the regulation of the fluid entering the tubing from two or more zones. Under proper conditions this may result in gas-lifting a considerable quantity of oil from a zone that would no longer flow. This use of reservoir energy, otherwise wasted, may result in a very considerable saving in lifting cost.

Summary

When several productive zones are present in a field, the wells should be drilled so that the production from each zone can be controlled without affecting other zones. The differences between zones in pressures, gravity and value of the oil, gas-oil ratio, edge-water conditions, sand production, and other factors make this desirable.

The conditions necessary to insure the practicability of multiple-zone wells are fairly rare. In general, California practice indicates that separate wells to each zone are to be preferred to multiple-zone wells because of additional recovery and fewer operating difficulties.

The primary reasons for the use of multiple-zone wells, in almost all cases, have been limited space, offset requirements, and increased potentials per well.

In general, multiple-zone wells are recommended:

1. When most of the recovery will be by natural flow (perhaps aided by repressuring), the pumping life short, and the field deep.
2. When the energy of one zone can be used as a natural gas lift for oil from another zone.
3. When space is limited and the number of wells is restricted.
4. When the establishing of high gas or oil potentials per well is important.

In most cases in which a multiple-zone well is desirable, a two-zone well is to be preferred to the three-zone well. The advantages of a three-zone well over a two-zone well are likely to be more than offset by the difficulties inherent in the more complex installation.

Technical Details of Multiple-Zone Production*

Basically, a multiple-zone well is simple. The requirements are merely that the zones be separated inside and outside the liner, so that the production from each zone can be controlled separately. The complex problems are the results of efforts to insure the best possible producing conditions and at the same time meet the new problems that every field and almost every well present.

The separation of the zones outside the casing requires that cement be placed between the zones qutside the line. This is done either by cementing blank pipe through the zones and perforating the pipe in the hole, by cementing blank pipe between the zones, or by a combination of both. Cementing blank pipe through the zones and perforating the pipe in the hole involes no special problems. Cementing blank pipe between two perforated sections is difficult, because separation of the zones must be attained; and when intermediate water is present between the zones, a water shutoff must be obtained above and below this water. All this must be done without allowing cement to plug up the perforations or foul the face of the oil sand. When intermediate water is not present, the zones are not difficult to separate with small quantities of cement. When a top and bottom water shutoff is necessary, a considerable excess of cement is desirable to insure that the cement behind the pipe is not contaminated.

The usual method of cementing the blank section is to have a cement basket at the bottom of the blank section with cementing ports just above the basket. At the top of the blank section there is an inverted cement basket with ports into the liner just below it. Cement is forced out of the cementing ports, using inverted swabs or special tools on the bottom of tubing or drill pipe. The regular cement basket prevents the cement from going below the blank section. The inverted cement basket prevents the excess cement from going above the blank section outside the liner, thus forcing the cement back into the liner. The excess cement then is circulated out readily.

As many blank sections as desired can be cemented by the foregoing method, starting with the bottom blank section and working up.

Frequently two liner sizes are run in an effort to get better cement jobs. In a three-zone well this usually means that a liner is run through the upper two zones. These two zones are separated outside the liner by cementing a blank section as outlined hereinbefore. A smaller liner then is run through the bottom zone, with a slight overlap. The blank portion on top of the smaller liner then is cemented, to separate the bottom and middle zones (see detail *1*, Fig. 1). Sometimes the bottom portion of the large liner is blank, and this blank section is cemented between zones. After the cement has been drilled out, a smaller liner is hung through the bottom zone, using a lead seal liner hanger. Detail *3*, Fig. 2, shows this procedure used in a two-zone well.

Some wells have been cemented with the use of a "sectional" liner. The bottom section is run

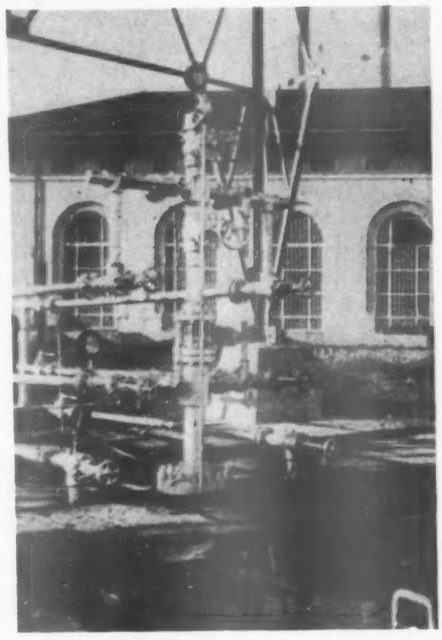

Fig. 4—A three-zone tree

with a "mating sleeve," or nipple, on top, large enough to receive a full-size blank mandrel of the casing being run. The blank pipe above the perforated interval then is cemented, using a cement basket collar. Any desired quantity of cement can be used, as there are no upper perforations to foul, and the excess cement can be circulated out readily after the liner section has been backed off. After the bottom section has been cemented the next section is run and telescoped into the "mating sleeve." The top portion of this section then can be cemented, and the process repeated for as many sections as desired. This method has been satisfactorily used in both vertical and deflected holes. It gives good cement jobs, but offers considerable other difficulties.

Separation of the zones inside the liner is achieved by packers. In a two-zone well the separation usually is attained by a packer on the tubing. Usually, downward movement is prevented by slips or a hookwall collar, and upward movement by setting part of the weight of the tubing on the packer. The use of packers with slips to prevent movement both up and down is not common, as they are not readily retrievable. Some use has been made of a special type of packer set in the liner before the tubing is run. A hole in the packer, with packing around it, is so arranged that a packoff will be made on the proper size tubing. Tubing with a guide shot on bottom and one or more joints of flush-joint perforated

(Continued on Page 183)

*The cementing of multiple-zone wells is treated very briefly herein. Much of it is condensed from a more complete treatment in the unpublished paper by C. J. Dean, "Multiple-Zone Wells and New Casing and Cementing Practices as Developed at the Wilmington Field, California," given at the Los Angeles, Calif., meeting of the American Institute of Mining and Metallurgical Engineers, Oct. 1938.

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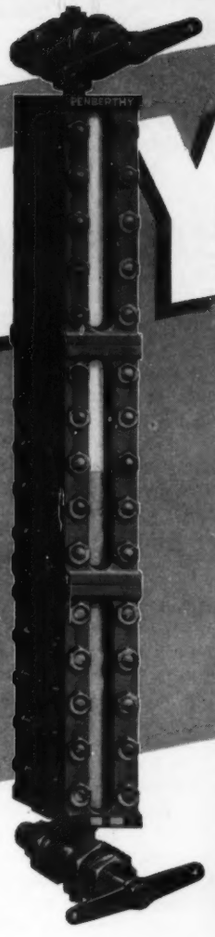

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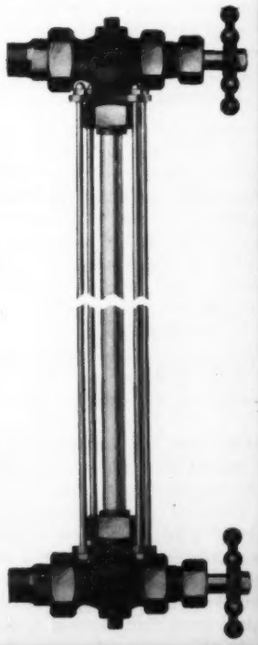

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Control of Gas-Oil and Water-Oil Ratios By Chemical Treatment

By HARVEY T. KENNEDY
Gulf Research & Development Co., Pittsburgh, Pa.

THE possibility of treating formations penetrated by the drill to render them impermeable appears to have been appreciated first by Swan.[1] His process consisted of vaporizing and solidifying naphthalene. In the following year Van Mills[2] recommended the use of solutions such as sodium silicate and sodium carbonate which react with oil-field waters to form solid plugging agents.

From the time of Swan and Van Mills up to 1935, little attention appears to have been paid to the question of formation plugging, probably because of disappointing results of treatments made with these types of materials. Appreciation of the importance of the problem in recent years is shown by the fact that, since 1935, 44 United States patents have been issued, dealing more or less directly with formation plugging, and a large number of experimental and commercial well treatments have been made.

In a recent article[3] Torrey gives an excellent review of various methods for the selective exclusion of water and gas from wells. His paper describes the several alternative methods available for the purpose, especial emphasis being placed on cementing technique. The present paper is devoted to presenting the available data on chemical treatments—particularly on treatments performed in the last few years.

Plugging Methods

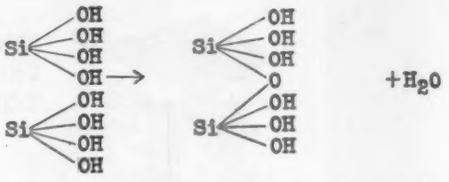
When it is desired to plug a given portion of open hole in an oil or gas well, there are three general methods by which it may be accomplished: "squeeze" cementing, cementing of liners with subsequent perforation, and chemical injection. Experience shows that each method has definite advantages under certain conditions. Due to its hardness, cement has definite advantages in plugging large pores, where softer material might be ineffective. It has the disadvantage of requiring drilling tools for the removal of excess cement in the hole; and, if tools are not conveniently at hand, the job may be unnecessarily expensive.

Cemented liners have the advantage of protecting loose or caving formations, and thus this method may be effective in certain areas where cementing or chemical treatment might fail.

Chemical plugging of formations differs from plugging with cement in two important respects. First, in regard to their ability to penetrate the formations, chemicals now in use have the property of changing from thin liquids, while being injected, to gels of various hardness after they have set in place. This is in contrast to cement, which comprises a suspension of fine particles having very limited depths of penetration into the body of the formation. Second, chemicals in general do not set up to the hardness of cement, and do not require the use of drilling tools for the removal of the excess that remains in the hole. Thus, chemical treatment has the unquestioned advantage of being applicable to formations too tight to receive cement—and, in general, the excess chemical may be easily removed with an ordinary bailer. This lack of hardness, of course, precludes its use when rigidity and strength are required, so that attempts at sealing loose or caving formations with present-day chemicals have generally met with failure; for, although the hardness of the gels may be made sufficient to plug the pores of the formation, the formation itself must be the main source of mechanical strength.

As both the setting time, which has an important effect upon depth of penetration, and the hardness finally attained depend upon the temperature and pressure of the formation, the choice of a suitable chemical is of paramount importance in successful treatment. Up to the present time it appears that the greatest success has been attained by the use of various silica sols which, on standing, are transformed into silica gels whose hardness and setting time may be controlled by the composition and method of mixing.[4]

Silica sols may be prepared in either acid or alkaline medium, and a wide variety of mixtures has been employed. According to Lehnhard and Reimers, the setting of the sol into a gel takes place because of the elimination of water from the silicic-acid molecules, as illustrated by the following reaction:



The polymerization is pictured as progressing until very large molecules, containing hundreds of silicon atoms, are formed—the water eliminated from the molecules remaining in place in the gel much as a sponge holds water.

At present there is a reasonable amount of data—certainly enough to be reliably diagnostic—on the results of chemical treatment applied for three purposes: (1) treatments to eliminate water flows in wells being drilled with cable tools; (2) treatment of producing oil and gas wells to eliminate water; and, (3) treatment of oil wells to reduce the gas-oil ratio.

A recent development of considerable importance in the successful treatment of wells is the method of following the chemicals charge by a nonpenetrating fluid, described by Irons.[5] The nonpenetrating fluid generally consists of an organic jelly, frequently containing cellophane scrap or similar surface plugging material. When first mixed, the fluid is easily pumpable; but, by the time it reaches the bottom of the well, it gels to such an extent that it completely plugs the surface of the formation. Nonpenetrating fluids of this type not only give a definite pressure signal when all the chemical charge has been injected, but also make it possible to hold a high pressure in the well after treatment, which prevents circulation of the fluid in the well and consequent loss of chemical charge.

Drilling Wells

Although the treatment of drilling wells does not come strictly within the scope of the title of this paper, the methods employed are so similar to producing-well treatments that a brief resume of this work seems to be appropriate.

Successful treatment of a cable-tool drilling well may avoid the necessity of drilling with a hole full of water, or it may eliminate one or more strings of casing. A very high percentage of successful treatments has been obtained when appreciable volumes of chemical were injected into consolidated sands previously isolated by means of packers. In unconsolidated formations like the glacial drift in Michigan, however, no success has been attained. Characteristic behavior in the glacial drift after treatment is that no water would enter the well until a fairly low differential pressure had been reached, at which the water would "break through"—indicating the probability that the formation had caved. Records of successful treatments of drilling wells may be found in a paper by Hefley, Kennedy, and Fitzgerald, privately printed by Dowell Inc., Tulsa, and in other trade papers issued by that company.

Water Shutoff in Producing Wells

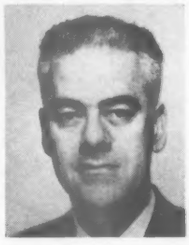
The second class of treatments involves the injection of chemical into water-bearing sections of producing oil or gas wells. Although much investigative effort has been directed toward the finding of chemicals and technique which selectively would plug water-bearing portions of wells, commercial success, with few exceptions, has been limited to complete plugging of predetermined portions of porous formations. It is thus necessary to determine the point of water entry before reasonable success can be expected. Up

(Continued on Page 96)

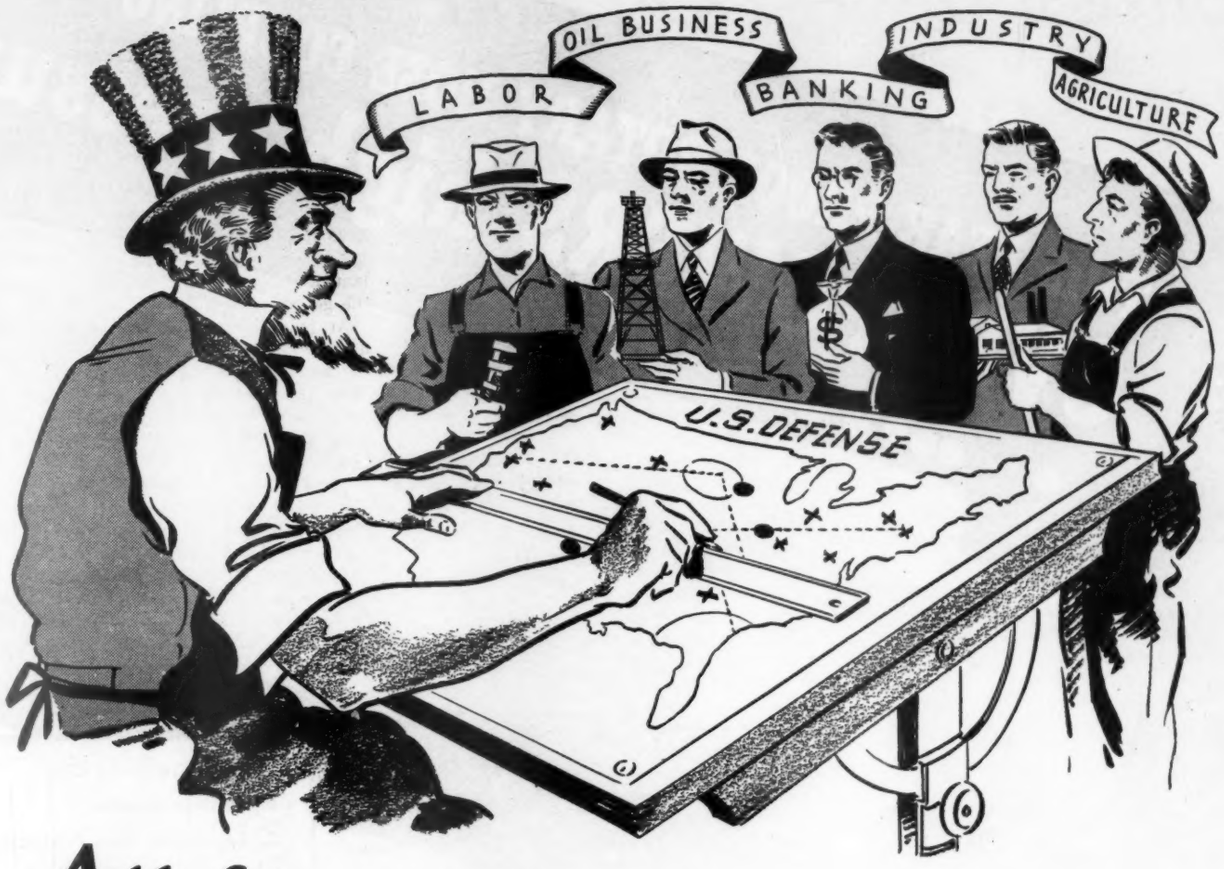
A. P. I.

ABSTRACT

This paper describes typical chemical treatments for reduction of gas and water-oil ratios by the plugging of selected portions of the producing formations, and mentions briefly similar treatments applied to cable-tool drilling wells to shut off excessive water. Records of 6 water plugging treatments, chosen to represent various successful treating methods, and 11 gas plugging treatments are included. The latter group consists of all the applications up to the present time of chemical plugging methods to the wells of two major companies in the Goldsmith pool, Ector County, Texas. Conditions essential for successful application of chemical plugging methods are discussed.



Paper presented before Division of Production at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.



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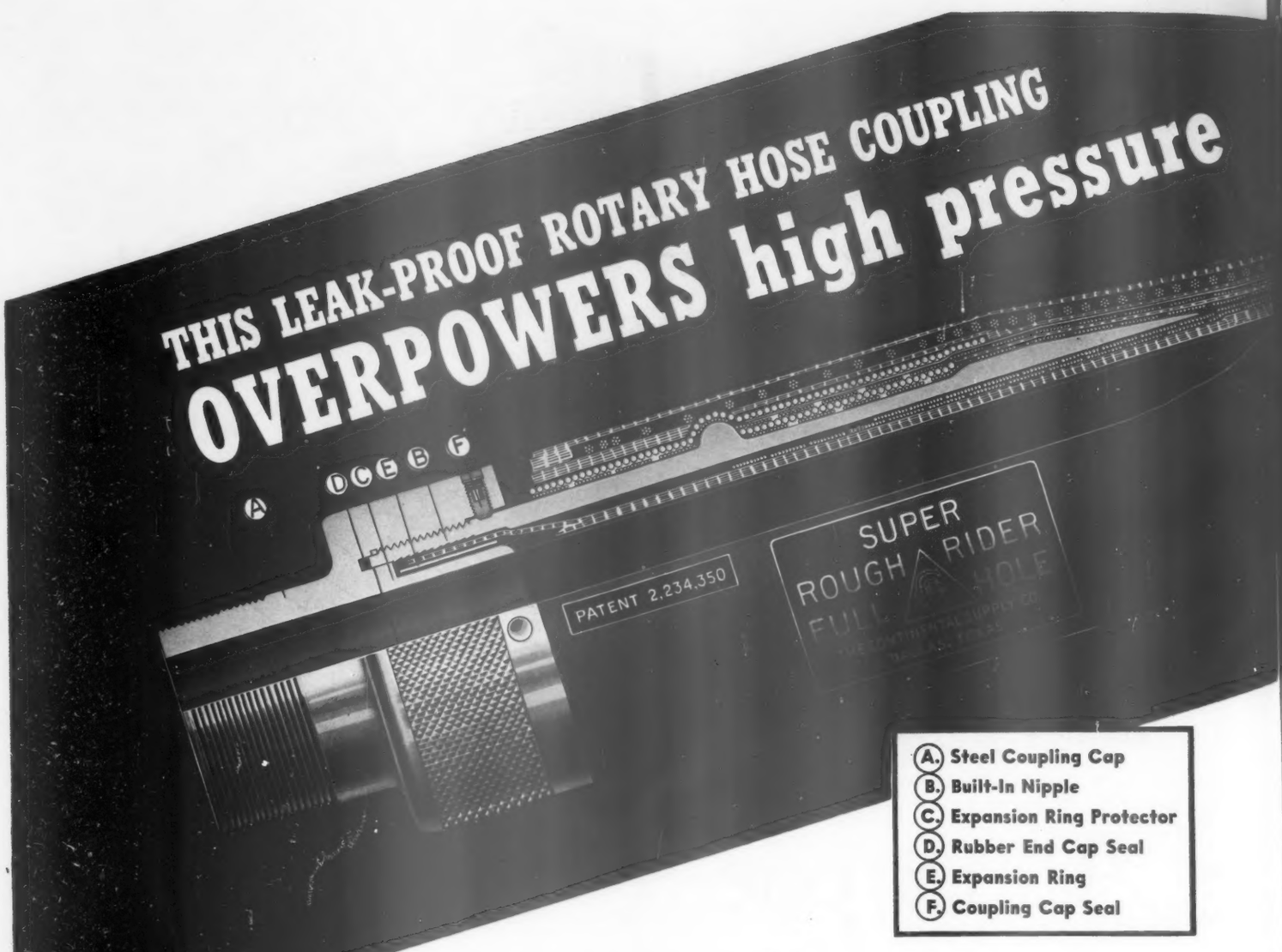

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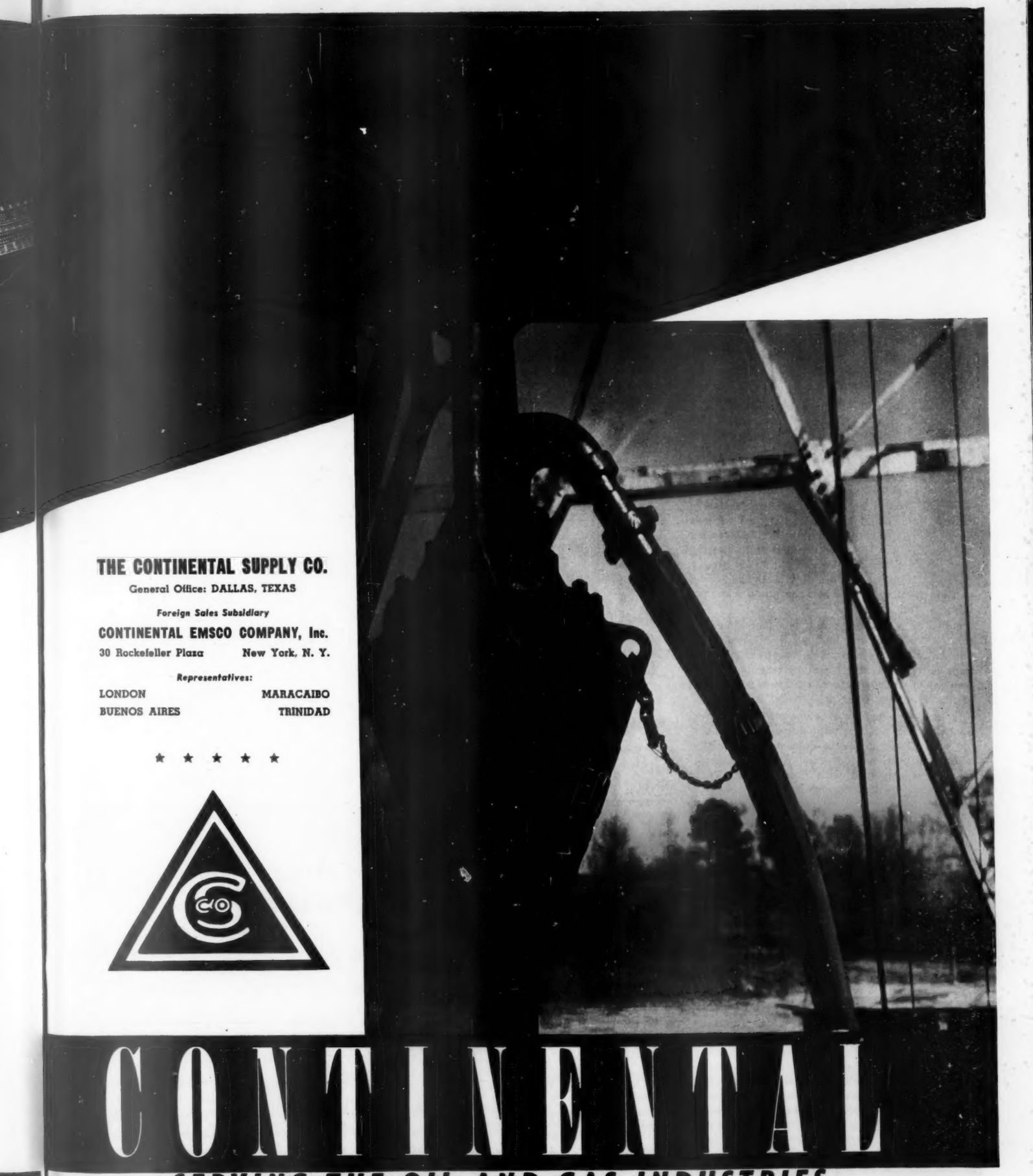

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SERVING THE OIL AND GAS INDUSTRIES

to the present time the only completely reliable method for this purpose has been the use of packers, by means of which the oil-bearing and water-bearing parts of the open hole may be logged definitely.

Methods of treating producing oil and gas wells to exclude water have varied considerably, depending upon the amount of information available regarding the point of entry of the water and the condition of the hole. The best results have been obtained when the water-bearing and oil-bearing formations have been separated by packers, pumping tests being made above and below the packer at each setting by means of a circulating tool. An example of this type of treatment is the 3 H. Coffman in the Chase pool, Kansas.

The 3 Coffman was completed in the silicious lime in November 1935, pumping about 300 bbl. of oil and no water in 24 hours. After it had been acidized twice with 1,000 gal. of acid, it produced 683 bbl. of oil and 140 bbl. of water per day. At the time of treatment, in February 1939, the well was pumping 14 bbl. of oil and 636 bbl. of water in 24 hours. Pumping tests, with a packer set in the center of the open hole, indicated that most of the water was coming from loose sections in the lower portion of the hole. The well could not be pumped down, and treatment was made below the packer. After treatment, the well produced 30 bbl. of oil and 50 bbl. of water, which fluid is about what was expected from the section above and behind the packer. The increase in oil flow resulted from the fact that, after treatment, the well was pumped off; whereas, before treatment, only a slight lowering of fluid level resulted when the pump was operating at full speed.

Other wells in Kansas and Oklahoma have been treated by the same method, and have shown uniformly good results. With one possible exception, every recent treatment by this method has resulted in the complete and permanent plugging of the treated section.

In lieu of packers, the bridge method disclosed by Lehnhard[6] may be used during treatment of the well. Other ingenious devices for protecting oil-bearing portions of the hole during treatment have been employed with good results. These methods are particularly important in areas where wells have been shot or heavily acidized, and packers cannot be set at the desired locations. Many producing wells have been treated merely by the pumping of chemical into the bottom of the well and allowing the chemical to enter such formations as it will. The percentage success of such methods is low, due probably to a number of causes. In some cases, no doubt, considerable plugging has resulted, but the remaining fluid-producing capacity of the wells has been so large that the pump capacity is still the determining factor. In other cases it was found that, when the well was standing, water was entering the hole from high-pressure formations and flowing out of the hole into lower-pressure formations. Under these circumstances, chemical would be washed rapidly out of treated formations. In one case, 1,500 gal. of chemical was injected into the bottom of a well. On subsequent testing, no effect of the treatment could be observed. A packer then was set in the formation above the reservoir sand, and same volume of chemical applied. After the second treatment, the formation was found to be plugged completely, indicating that the first chemical charge probably had circulated out of the hole due to a leaking casing.

Ordinarily, chemicals with 1 to 4 hours' setting time are prepared at the surface and pumped through tubing and spotted at the desired level. Frequently, circulating tools are employed which allow the fluid ahead of the chemical to be displaced in the casing, ports of the tool being closed when the chemical reaches the bottom. In this way a considerable amount of injection time is saved, and the chances of the formation face becoming plugged are reduced.

Injection pressures vary considerably from one formation to another, and with the rate of injection; but, in general, these pressures are low, and it is significant that the phenomena of "breakdown" pressures typical of squeeze cementing are not observed. In general, the pressures required do not exceed greatly the pressures required to force water into the formation at the same rate, and in many cases no surface pressure is required.

Results of a large number of treatments on producing oil wells for water shutoff can be found in the literature.[4,7] Lehnhard and Reimers describe a number of these treatments, and give detailed description of the chemicals used. Results on several wells treated cooperatively by the Gulf Oil Corp. and Dowell Inc., are shown in Table 1. An arrangement of equipment frequently employed is shown in Fig. 1.

From Table 1 it is noted that the reduction of the water-oil ratio frequently is accompanied by an increase in the oil production. The reason for this effect is found in the fact that many wells are not pumped down under the limited capacity of normal pumping speeds. After the portion of the hole that produces the most water has been plugged and the pump has been relieved of the handling of this excess water, the remainder may be produced against lower back pressure, with resultant increase in oil production. All of the pumping wells in the table except well "B" had

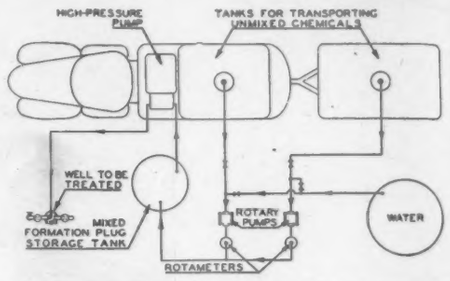

Fig. 1—Arrangement of equipment—chemical treatment

pumped-down capacities considerably greater than the capacity of the pump. In treating these wells, high water-oil-ratio sections of the hole were selected for plugging, but in no case could a section be found that produced water without some oil.

The treatment of well "B" illustrates the possi-

(Continued on Page 186)

TABLE 1—WATER-SHUTOFF TREATMENTS IN PRODUCING OIL WELLS

Well	Field—	Producing formation—	Production Before Oil (Barrels)	Production Before Water (Barrels)	Production After Oil (Barrels)	Production After Water (Barrels)	Remarks:
A	Seminole, Oklahoma	Simpson lime	12	671	18.5	329	Treated under packer. Pumped-down capacity before treatment, 1,343 bbl. of fluid; after treatment, 344 bbl.
B	Seminole, Oklahoma	Simpson lime	0.44	188	3	9.4	Well completely plugged, and then entire producing section shot with 5 qt. and 10 qt. nitroglycerin.
C	Silica, Kansas	Arbuckle lime	84.5	876	120	784	Treated under packer. Well could not be pumped down before treatment.
D	Seminole, Oklahoma	Wilcox	23	430	22	100	Treated section entirely plugged. Water after treatment coming from leaking casing seat.
E	East Texas	Woodbine	40%	60%	100%	...	Flowing well. Bottom 15 ft. of 21-ft. producing section plugged. Top section protected by pumping oil down casing during treatment.

TABLE 2—CHEMICAL FORMATION PLUG TO REDUCE GAS-OIL RATIO

Well	Feet plugged	Gallons of chemical used	Gas volume (Thousands of cubic feet) Before	Gas volume (Thousands of cubic feet) After	Gas-oil ratio (Cubic feet per barrel) Before	Gas-oil ratio (Cubic feet per barrel) After	Remarks:
A-1	19	3,000	5,500	1,233	26,352	3,543	Oil decreased from 210 bbl. to 105 bbl. per day; 500 gal. acid resulted in 348 bbl. per day.
A-2	5	1,000	4,300	200	92,511	2,737	Well shot with 50 qt. to increase oil production after treatment.
A-3	11	3,000	5,400	332	28,421	4,311	Oil decreased, but production was regained by 55-qt. nitroglycerin shot.
A-4	6	1,500	1,734	413	44,461	2,185	Well previously squeezed with 65 sacks cement, without success. Shot with 60 qt. nitroglycerin, shot after chemical treatment.
A-5	10	3,000	2,800	338	13,861	4,389	Oil production decreased by formation plug—well shot with 100 qt.
A-6	4	1,500	5,400	504	11,850	5,196	Cut oil from 450 bbl. to 150 bbl. per day.

TABLE 3—CHEMICAL FORMATION PLUG TO REDUCE GAS-OIL RATIO

Well	Feet plugged	Gallons of chemical used	Gas volume (Thousands of cubic feet) Before	Gas volume (Thousands of cubic feet) After	Gas-oil ratio (Cubic feet per barrel) Before	Gas-oil ratio (Cubic feet per barrel) After	Remarks:
B-1 (C-9)	6	750	§1,100	20	15,158	1,435	At first produced by gas lift, now flowing.
B-2 (C-10)	14	*300	†1,300	4	42,600	320	Well produced by gas lift.
B-3 (C-17)	9	2,750	‖13,700	†6,000	‡6,402	200,000	Unsuccessful in lowering gas—three stages used. Gas coming from behind pipe.
B-4 (C-19)	11	3,000	¶7,600	3,200	8,629	492,103	Unsuccessful in lowering gas—two stages used. Gas coming from behind pipe.
B-5 (C-11)	15	1,000	**864	3	6,758	212	Well produced by gas lift.

*Only 300 gal. of 1,000-gal. treatment went into formation. †2½-in. casing outlet. ‡5/32-in. choke, oil production 5 bbl. per day. §Original potential test, 2½-in. casing outlet. ¶Original potential test, ¾-in. choke. ‖Original potential test, 2½-in. casing and 2-in. tubing outlets. **Original potential test, open 2-in. tubing.

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Oil-Well Tests Suggest New Rating Standards

By H. E. DRALLE and E. H. LAMBERGER
Petroleum and Chemical Engineering, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

SINCE oil-well pumping began, the existence of many variables which directly affect equipment ratings and indirectly influence the economies of production has been recognized. Much has even been written about the theoretical mechanics of oil-well pumping in an effort to segregate and control these variables, with the ultimate purpose of minimizing over-all production costs which are reflected in all of the pumping equipment used on a well.

Actual data of a fundamental and basic nature to temper the theories evolved for solving recognized pumping problems have been limited, at best, and usually have been obtained more or less haphazardly on wells in widely separated localities and under uncontrolled operating conditions. Such data, voluminous as they are, served valuable purposes; but they do not permit segregating the effects of important variables and determining their true relations to designs of well-pumping apparatus from the power source to the pump at the bottom of the well.

Many oil-producing companies, from costly operating experiences, long had recognized the shortcomings of such existent test data and the need for some which are more factual and basic, but not until recently was there a direct effort made to obtain such data.

Largely in the interest of attempting to improve economies in their own producing operations, the Phillips Petroleum Co., in the spring of 1940, in collaboration with Sargent Engineering Corp. and the Westinghouse Electric & Manufacturing Co., undertook the collection of comprehensive and exhaustive test data on a single pumping well in the Oklahoma City field, for the purpose of facilitating an analytical study of the magnitude and types of loads and displacements simultaneously occurring during a pumping stroke at many important points in the mechanical system from the prime mover at the surface to the pump at the bottom of the well. The value of making tests on a single well, under controlled conditions, is immediately apparent. Under such conditions it is possible, at will, to alter a single variable independently, holding all others constant, and to observe its effect upon the over-all operation. From a complete analysis of such data, it at once becomes possible to set up formulas for predetermining the performance of a well or for rating equipment for any known set of well conditions. Any one of several phases of these tests easily might furnish desirable material for other papers before the American Petroleum Institute, but in this paper are discussed briefly only conclusions of immediate general interest to the producing branch of the industry; these conclusions are supported with suitable data to warrant their authenticity.

The tests from which our conclusions have been drawn number in excess of 200, each with varying conditions of speed, stroke length, counterweighting, plunger sizes, tubing diameters, and types of prime movers. Electrical instruments were placed as shown diagrammatically in Fig. 1: in the low-speed gear shaft to measure torque; on the pitman to show tension and compression; at two

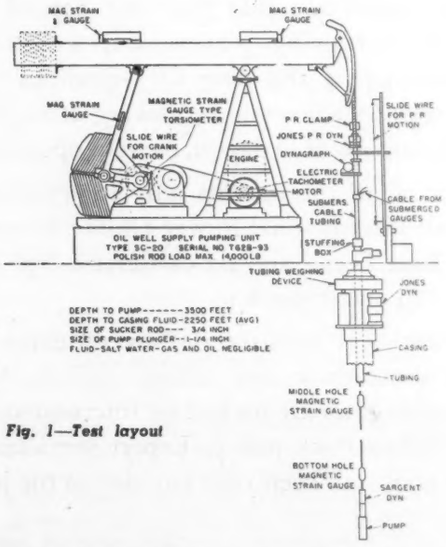


Fig. 1—Test layout

A. P. I. ABSTRACT

H. E. DRALLE

E. H. LAMBERGER

In oil-well pumping there are many known variables which directly affect the design and application of equipment used in the economical production of oil. To ascertain the individual effects of these variables on the performance and ratings of oil-well equipment and to augment the many theoretical considerations already given to them, Phillips Petroleum Co., Sargent Engineering Corp., and Westinghouse Electric & Manufacturing Co. jointly made a series of more than 200 tests, extending over a continuous period of 6 months.

The actual tests included independent variation of the speed, stroke length, counterweighting working-barrel size, tubing diameter, and type of prime mover. Under these varying conditions, oscillographic film was used to show 14 simultaneous records of instantaneous loads and displacements occurring during a pumping cycle.

Instruments were placed in the incoming power line, in the low-speed gear shaft, on the pitman, at two different points on the walking beam, on the polished rod, and at two different points in the sucker-rod string Correlated with these were polished-rod dynagraph charts and bottom-hole dynamometer records.

The paper covers that part of these tests which suggests the development of new formulas for predetermining, from a known set of well conditions:

1. **Peak polished-rod load.**
2. **Pump plunger stroke.**
3. **Peak crankshaft torque.**

These new formulas, with supporting data, are given, and results from their use compared with those obtained from existing formulas and with actual test results. Suggestions also are made that other perplexing problems incident to oil-well pumping may be solved conveniently with these same basic and fundamental test data.

Paper presented before Division of Production at annual meeting of American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

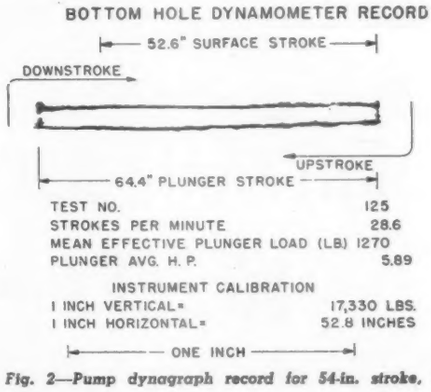


Fig. 2—Pump dynagraph record for 54-in. stroke, 30 s.p.m.

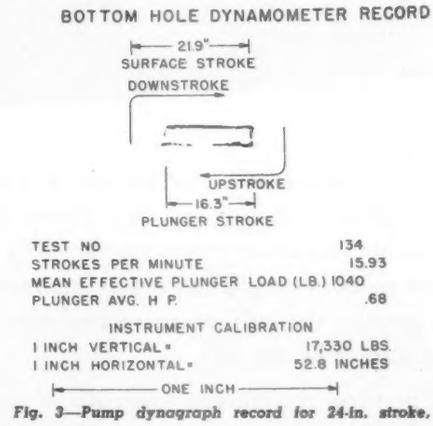


Fig. 3—Pump dynagraph record for 24-in. stroke, 16 s.p.m.

points on the walking beam to register bending; on the polished rod and at two points in the rod string to measure tensile and compressive loads in the sucker-rod string. In addition the voltage, current, and power of the incoming power line also were recorded simultaneously by the oscillograph. With such location and arrangement of instruments it was possible to obtain simultaneous records of 14 instantaneous loads and displacements during a pumping cycle. Dynagraph and bottom-hole dynamometer records also were taken simultaneously, and are shown in Figs. 2 and 3.

Close analysis of the records permits interesting conclusions on four topics as enumerated, and as will be discussed briefly under self-explanatory headings:

(*A*) Peak polished-rod loads.
(*B*) Effective pump-plunger stroke.
(*C*) Peak torques on the crankshaft.
(*D*) Effect of prime mover on plunger stroke, peak polished-rod load, and peak torque.

(A) Peak polished-rod loads

The polished rod, as the connecting link between the surface and subsurface equipment, is easily accessible and commonly used as the point for mechanical measurement of well loads with dynamometers. When such instruments are not readily available, it is desirable to be able to calculate closely the peak-load values for any known set of well conditions. The peak loads vary widely with stroke length and speed of pumping, as shown by curves of actual values given in Fig. 4 (see also Table 1). For such calculations a new formula,* developed theoretically and proved by these test results, is proposed and may be expressed as follows:

$$PPRL = W_R\left(1 + \frac{ESK_1}{24L^2\delta_e}\right) + 2W_o\left(\frac{E_oS\omega}{24a_oL\delta_o}\right) + 2W_{oD} - W_{Rb}$$

where
$PPRL$ = peak polished-rod load, in pounds.
W_R = weight of rod string, in air-pounds.
W_{Rb} = weight of fluid displaced by full length of rod string (buoyant force), in pounds.
W_o = weight of full height (to pump) of fluid column on net area of pump plunger, in pounds.
W_{oD} = differential fluid load—weight of net fluid head on full area of plunger—in pounds.
E = Young's modulus of rod material, in pounds per square inch (p.s.i.).
E_o = Young's modulus of fluid column, in pounds per square inch (p.s.i.).
L = length of rod string, in feet.
S = polished-rod stroke, in inches.
a_o = velocity of sound in fluid, in feet per second.
K_1 = factor (calculated from specific data on rod string, speed of pumping, and depth of well).
ω = angular velocity of crank, in radians per second.
δ_e = effective density of rod material.
δ_o = weight, in fluid-pounds per cubic inch.

†Density of normal rod material increased by the ratio: $\frac{\text{Weight of total rod string including couplings}}{\text{Weight of rods only}}$

A simplification of the formula to make it more practical for field use, and in which basic well data only are used, is given by the expression:

$$PPRL = W_R - W_{Rb} + W_{oD} + 0.75\,SN\,[17A\tan(0.0004\,LN)^\circ + A_o]$$

Where:
W_R = weight of rod string, in air-pounds.
W_{Rb} = weight of fluid displaced by full length of rod string (buoyant force), in pounds.
W_{oD} = differential fluid load — weight of net fluid head on full area of plunger — in pounds.
N = number of strokes per minute (s.p.m.).
A = area of sucker rod, in square inches.
L = length of rod string, in feet.
A_o = net plunger area, in square inches.

*Developed by B. F. Langer, Westinghouse research engineer.

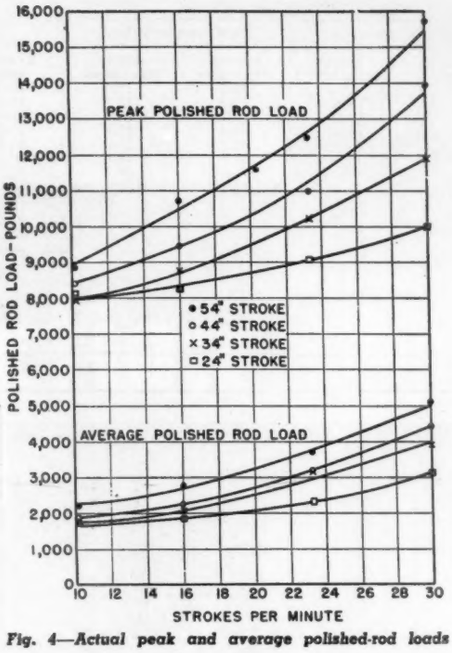


Fig. 4—Actual peak and average polished-rod loads

In case a table of trigonometric functions is not readily available, the term *tan* $(0.0004\,LN)^\circ$ may be calculated from the equation:

$$\text{Tan}\,(0.0004\,LN)^\circ = x + \frac{x^3}{3} + \frac{2x^5}{15}$$

Where:
L = length of rod string, in feet.
N = number strokes per minute (s.p.m.).
$x = \dfrac{0.0004\,LN}{57.3}$.

Fig. 5 clearly shows how closely the curve derived from this new formula checks actual test results for 54-in. and 24-in. stroke lengths on a 3,500-lb. pump setting; also how it compares with the curve obtained from the present A.P.I. formula.[1] It is readily apparent that, with the new formula, the peak polished-rod loads may be predetermined with relatively close accuracy at any pumping speed, whereas the present A.P.I. formula gives results much too low at high pumping speeds.

The practical value of the new formula in relation to the design of apparatus and its economical application to pumping wells will be evident from a study of Fig. 6, which shows three curves of peak polished-rod load as ordinates plotted against the number of pumping strokes per minute as abscissae. Curve *A* is derived from the present A.P.I. formula; curve *B*, from the new formula; and curve *C*, from actual test results.

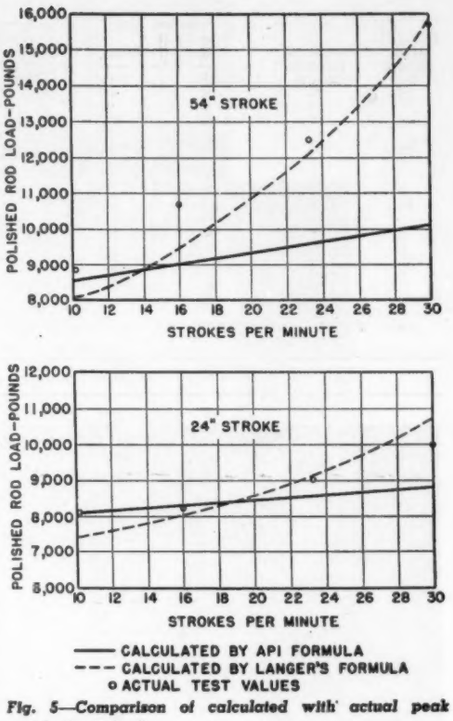


Fig. 5—Comparison of calculated with actual peak polished-rod loads

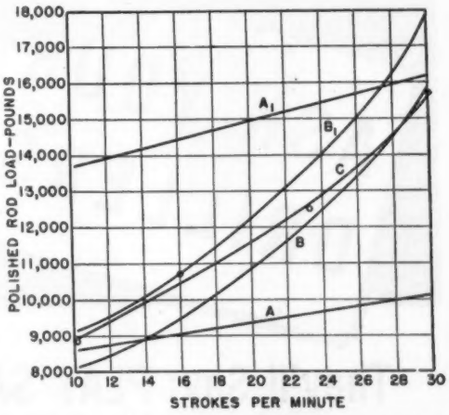


Fig. 6—Actual peak polished-rod loads and calculated values with required safety factors—54-in. stroke

Curves A_1 and B_1 are derived from applying a constant factor to the curves *A* and *B* to make their values at any point always exceed test results, a condition which is necessary for safe design and application of equipment. These curves also show the peak polished-rod loads for which

TABLE 1—ACTUAL PEAK POLISHED-ROD LOADS

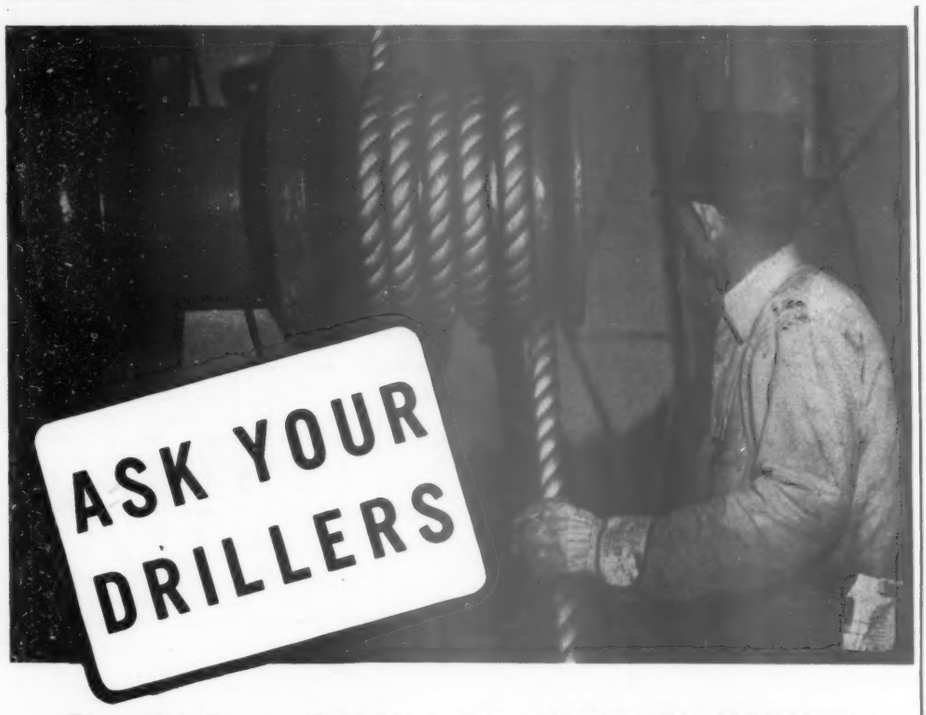
Nominal stroke length (in.)	Nominal (s.p.m.)	Number and types of counterweights: Rotary	Number and types of counterweights: Beam	Actual peak polished-rod load (lb.): Rotary counterweights: Normal-slip motor	Rotary counterweights: High-slip motor	Beam counterweights: Normal-slip motor	Beam counterweights: High-slip motor
24	10	8	16	8,110	7,800	8,150	8,380
	16	8	16	8,240	8,280	8,420	8,350
	24	8	17	9,050	9,420	9,460	9,260
	30	8	17	10,010	9,640	10,620	10,510
34	10	12	16	7,950	8,240	8,540	8,240
	16	12	17	8,720	8,940	9,175	8,760
	24	12	17	10,180	10,380	10,100	10,100
	30	12	17	11,930	11,780	12,380	11,880
44	10	16	17	8,390	8,420	8,870	8,280
	16	16	17	10,000	9,440	9,260	9,500
	24	16	17	11,000	11,200	10,880	10,810
	30	16	17	13,960	13,240	13,700	14,000
54	10	18	17	8,870	8,800	9,190	8,650
	16	18	17	10,690	10,630	10,290	10,230
	24	18	17	12,500	12,500	11,800	12,250
	30	18	17	15,700	14,710	.....	.....

Note: Fig. 4 is plotted from data for rotary counterweights with normal-slip motor.

TABLE 2—ACTUAL PLUNGER STROKE

Nominal stroke length (in.)	Nominal strokes minute	Number and type of counterweights		Actual plunger stroke (inches)				
				Rotary counterweights		Beam counterweights		
		Rotary	Beam	Normal-slip motor	High-slip motor	Normal-slip motor	High-slip motor	Average
24	10	8	16	16.6		15.3	15.5	15.8
	16	8	16	16.3	16.3	15.5	15.5	15.9
	24	8	17	22.6	22.7	21.1	21.6	22.0
	30	8	17	27.2	26.6	26.4	25.8	26.5
34	10	12	16	26.1	25.6	24.2	25.3	25.3
	16	12	17	26.9	27.4	25.8	26.9	26.8
	24	12	17	32.8	33.0	•32.5	32.2	32.6
	30	12	17	40.5	38.4	40.6	39.0	39.6
44	10	16	17	36.4	35.8	33.7	36.9	35.7
	16	16	17	40.0	39.6	37.4	39.8	39.2
	24	16	17	44.2	45.9	43.5	45.1	44.7
	30	16	17	54.5	50.8	52.5	50.6	52.1
54	10	18	17	48.1	48.5	45.3	48.0	47.5
	16	18	17	50.8	51.1	49.0	51.4	50.6
	24	18	17	54.8	53.9	54.3	60.2	57.2
	30	18	17	64.4	58.8			61.6

Note: Fig. 8 is plotted from the averaged values.



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equipment would have to be designed and applied to meet successfully any variable producing conditions occurring during the life of the well. This factor, for the sake of convenience, may be called the "safety factor of application" and, obviously, is one which is superimposed automatically upon all of the similar factors already embodied in the equipment designs.

A direct comparison between curves A_1 and B_1 with curve C shows the "safety factor of application" to be of the order of 1.6 for the A.P.I. formula, as compared to 1.1 for the proposed new formula. The smaller this "safety factor of application" the more economically can pumping equipment be designed and applied, because it is possible to use with confidence known fundamental data on materials. Also it will be possible to employ controlled and relatively inexpensive laboratory tests, rather than actual field tests, on wells to predetermine design adequacies of any mechanical equipment.

It should be noted that by using the correct "safety factor of application" it is possible with either the A.P.I. formula or the proposed new formula to apply pumping equipment exactly to meet a specific set of pumping conditions, any change from which immediately will result in the well being overequipped or underequipped, as illustrated by curves A_2, B_2, and C in Fig. 7. The

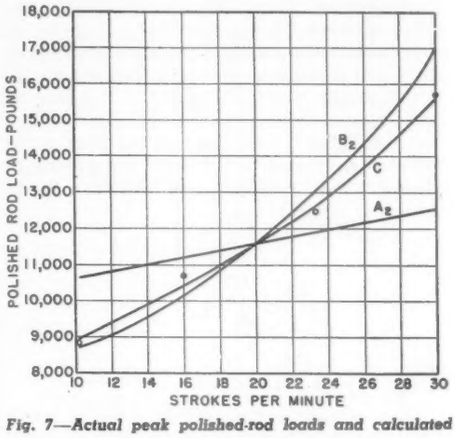

Fig. 7—Actual peak polished-rod loads and calculated values with safety factors required for 20 s.p.m.—54-in. stroke

curves A_2 and B_2 show the correct ratings of equipment for operation at 20 s.p.m., and are based on the A.P.I. and the proposed new formula, respectively. Lowering or raising the number of strokes per minute clearly shows the relative degree of overequipping or underequipping obtained by the two formulas, and illustrates the attending economies made possible by applying apparatus according to a formula which closely approaches test results over the entire practical range of speeds ever to be employed continuously on a pumping well.

(B) Effective pump-plunger stroke

Fluid production in a given period is a direct function of the linear displacement of the pump plunger during that period. In other words, at any given pumping speed, maximum production for that speed results when the effective plunger stroke is a maximum. The effective plunger stroke, however, for any surface stroke length varies widely with the speed of pumping, as shown by curves in Fig. 8 (see also Table 2).

The relation of plunger stroke to surface stroke at any pumping speed is a function of the overall rod-string elastic characteristics which, in turn, are dependent upon the size of sucker rods, the length of rod string, the damping factor of the rod string, the net fluid head, and the size of pump plunger. The only "unknown" of these characteristics is the damping factor which, fortunately, was found to be of minor consequence in

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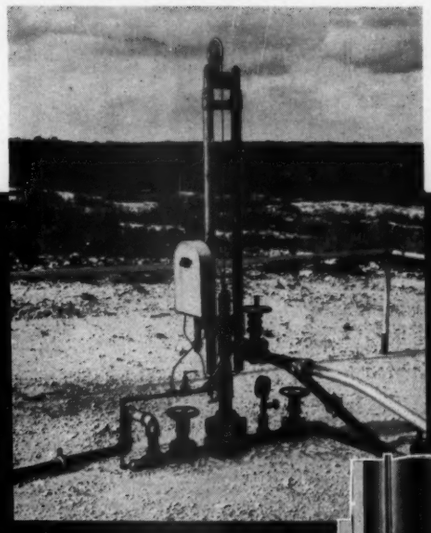

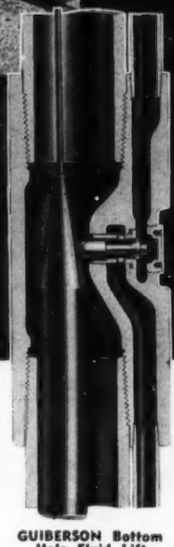

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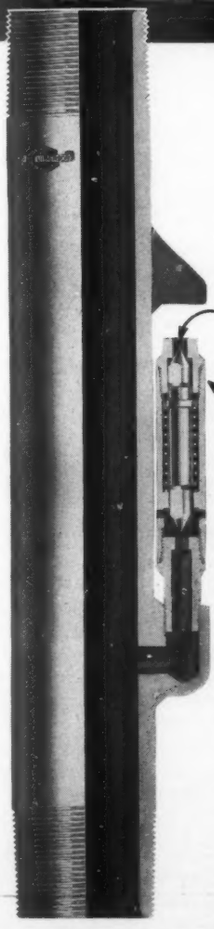
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TABLE 3—ACTUAL PEAK CRANKSHAFT TORQUES USING ROTARY COUNTERWEIGHTS

Nominal stroke length (in.)	Nominal strokes per minute	Number of counter-weights	Peak torque (thousands of inch-pounds) Normal-slip motor Upstroke Positive	Normal-slip motor Upstroke Negative	Normal-slip motor Downstroke Positive	Normal-slip motor Downstroke Negative	High-slip motor Upstroke Positive	High-slip motor Upstroke Negative	High-slip motor Downstroke Positive	High-slip motor Downstroke Negative
24	10	8	14	26	24	22	14	32	16	20
	16	8	22	32	34	22	24	26	34	18
	24	8	28	44	46	26	28	32	42	22
	30	8	32	44	32	28	36	26	34	26
34	10	12	30	36	34	22	30	36	34	26
	16	12	42	46	38	18	46	50	42	18
	24	12	78	38	70	24	66	66	74	18
	30	12	78	54	58	34	62	50	50	26
44	10	16	72	30	66	12	58	46	52	20
	16	16	70	66	62	22	80	42	68	38
	24	16	110	76	100	76	104	52	82	30
	30	16	134	82	80	40	98	56	70	36
54	10	18	104	44	72	28	98	28	76	24
	16	18	140	64	68	34	134	42	102	36
	24	18	192	88	148	64	170	39	114	32
	30	18	202	88	148	72	152	26	118	28

Note: Fig. 10 is plotted from maximum peak values, whether positive or negative, for normal-slip motor. Figs. 11 and 12 plotted from averages of positive peaks for up and downstrokes.

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the calculation of effective plunger stroke. For that reason, the damping factor will not appear in the final formula developed for practically calculating the effective plunger stroke for any specific set of well conditions.

Even though the damping factor (normally designated as gamma) does not materially affect the calculations and does not appear in the final formula, it is of interest to know that it does not change materially with the stroke length or speed on a single well, but may vary from well to well. In these tests gamma varies over the range of 0.12 to 0.58 (based on a value of 2.0 for critical damping).

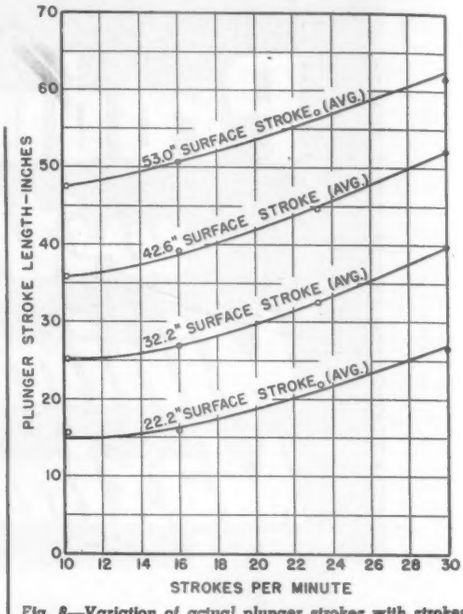

Fig. 8—Variation of actual plunger strokes with strokes per minute (s.p.m.)

Based on theoretical considerations, augmented by actual test results and previous work done by Mr. Rieniets[2] the following formula—the full development of which space does not permit—may be used for accurately calculating effective pump-plunger stroke:

$$EPS = \frac{S}{R} - \frac{24\,L\,W_{oD}}{E}\left(\frac{1}{A_R} + \frac{1}{A_T}\right)$$

Where:

EPS = effective plunger stroke, in inches (relative to unanchored tubing).
S = polished-rod stroke, in inches.
R = factor to be calculated.
W_{oD} = differential fluid load (weight of net fluid head on full area of plunger), in pounds.
L = length of rod string, in feet.
A_R = cross-sectional area of sucker rod, in square inches.
A_T = cross-sectional area of tubing, in square inches.
E = Young's modulus of rod material, in pounds per square inch (p.s.i.)

The factor R depends upon rod-string characteristics, depth of well, and damping factor; because it is difficult to calculate, a close approximation for its value has been used in the following condensed formula suggested for practical and general field use:

$$EPS = \frac{S}{\text{Cos}\,(0.0004\,LN)^\circ} - \frac{W_{oD}L}{2(10)^8}\left(\frac{1}{A_R} + \frac{1}{A_T}\right)$$

Where:

EPS = effective plunger stroke, in inches.
S = polished-rod stroke, in inches.
W_{oD} = differential fluid load (weight of net fluid head on full area of plunger), in pounds.
L = length of rod string, in feet.
A_R = cross-sectional area of sucker rod, in square inches.
A_T = cross-sectional area of tubing, in square inches.
N = number strokes per minute (s.p.m.).

In the absence of a table of trigonometric func-

tions, the cosine of the angle expressed as (0.0004 LN)° may be calculated from the equation:

$$\text{Cos } (0.0004\ LN)^\circ = 1 - \frac{x^2}{2} + \frac{x^4}{24}$$

Where:

$$x = \frac{0.0004\ LN}{57.3}$$

Fig. 9 shows curves of effective plunger stroke as obtained from the tests, as calculated by the Rieniets formula and as calculated by the proposed new Langer formula. The accuracy of the new formula is indicated plainly. Its practical use in production work should be of immediate value in arriving at optimum well-pumping conditions.

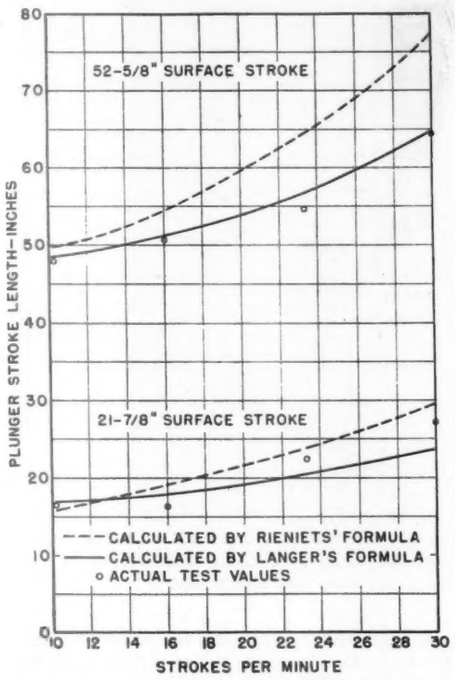

Fig. 9—Comparison of calculated with actual plunger strokes

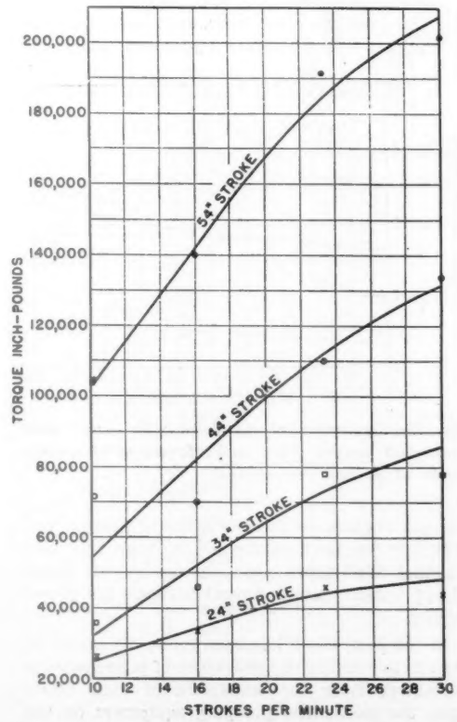

Fig. 10—Actual peak crankshaft torques—normal-slip motor, rotary counterweights

(C) Peak torques on the crankshaft

Crankshaft peak torque, used in determining application ratings for oil-well pumping gears, varies widely with the speed of pumping and the stroke length, as shown in Fig. 10 (see also Tables 3 and 4). For any specific stroke length and speed, the peak crankshaft torque depends upon the peak polished-rod load and the counterbalance effect. At present there are two accepted methods for calculating peak crankshaft torques[3]—one given by the expression $PCST = (P - CB)\ S/2$ and the other by the expression $PCST = 0.4P\ S/2$.

where
$PCST$ = peak crankshaft torque, in inch-pounds.
P = peak polished-rod load, in pounds.
CB = effective counterbalance force, in pounds.
S = stroke length, in inches.

Figs. 11 and 12 show actual and calculated peak torques for 54-in. and 24-in. strokes, respectively.

It is of interest to compare the curves of actual peak crankshaft torques with the curves obtained from the present A.P.I. formulas. It is evident that, although the expression $0.4PS/2$ is the more acceptable of the two for the conditions existing, it is still quite at variance with actual test results and, hence, not sufficiently accurate to permit predetermining, with safety, the peak crankshaft torque on a well-pumping equipment.

Curve B is the curve resulting from using, in the formula $0.4PS/2$, values of P (peak polished-rod load) as obtained from the new formula proposed previously in this paper. But even this curve shows the necessity for further improvement, which can be accomplished only by an entirely new formula.

Inasmuch as the actual peak crankshaft torque is a function of both the peak polished-rod load and the effective counterbalance, it is natural to expect that a formula properly including both

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TABLE 4—ACTUAL PEAK CRANKSHAFT TORQUES USING BEAM COUNTERWEIGHTS

Peak torque (thousands of inch-pounds)

Nominal stroke length (in.)	Nominal strokes per minute	Number of counter-weights	Normal-slip motor				High-slip motor			
			Upstroke		Downstroke		Upstroke		Downstroke	
			Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
24	10	16	28	22	24	22	12	36	12	28
	16	16	16	36	30	28	22	34	18	28
	24	17	44	36	48	24	46	34	40	22
	30	17	42	54	30	42	44	54	30	36
34	10	16	40	22	28	20	36	22	22	22
	16	17	40	42	40	30	42	54	34	24
	24	17	60	54	64	52	72	56	70	44
	30	17	106	84	74	62	86	82	56	70
44	10	17	42	40	44	26	42	30	50	22
	16	17	52	76	52	52	82	46	66	26
	24	17	120	88	121	78	108	84	88	68
	30	17	160	130	116	100	150	84	106	98
54	10	17	94	42	86	20	80	44	72	32
	16	17	128	90	102	42	120	96	94	50
	24	17	166	134	160	124	160	98	138	102
	30	17	...	...	...	...	...	...	...	...

Note: Figs. 11 and 12 plotted from averages of positive peaks for up and downstrokes.

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these variables is desirable. Then as the accuracy of either variable is improved and substituted in such a new formula, the resultant curve should approach more nearly the actual conditions.

At best, the development of a new and practical formula will be difficult of accomplishment due to verifying, with test data, the intricate calculations involved in connection with types of counterbalances, types and speed of prime movers, and speed of pumping. However, further analytical study of existing test data will be carried on with the definite idea of presenting at a future date a new formula for accurately predetermining

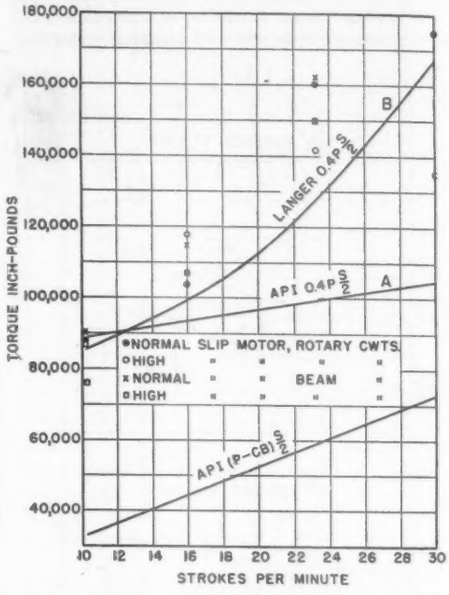


Fig. 11—Comparison of calculated with actual peak crankshaft torques, 54-in. stroke (averages of positive peaks of up and downstrokes)

peak crankshaft torque, with the practical result of being able economically to apply pumping gears.

(D) Effect of prime movers on plunger stroke, peak polished-rod load, and peak torque

Prime movers most commonly used in beam pumping today are either high-speed multicylin-

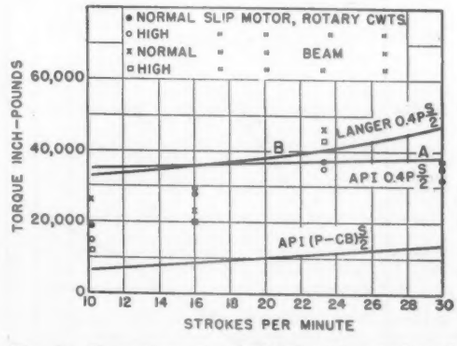
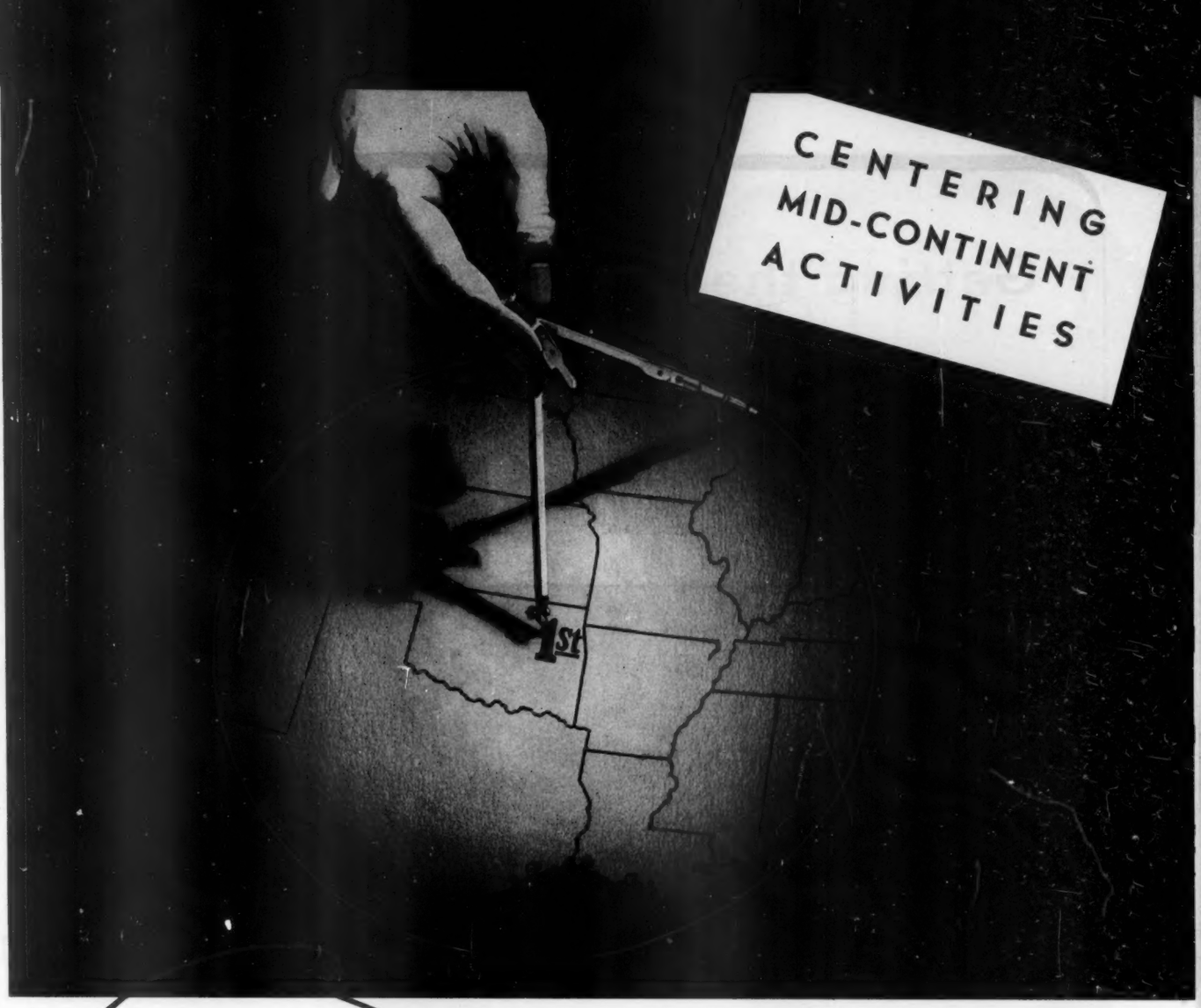


Fig. 12—Comparison of calculated with actual peak crankshaft torques, 24-in. stroke (averages of positive peaks of up and downstrokes)

der gas engines, or electric motors. Electric motors may be classified further as "high slip" and "normal slip" types, each having specific fields of application mainly dependent upon the power supply.

In the past, there has been much discussion of the relative merits of these types of prime movers considered from the standpoint of their effect upon the mechanical pumping equipment on the well, and much of a controversial nature still needs positive solution regarding this effect. As



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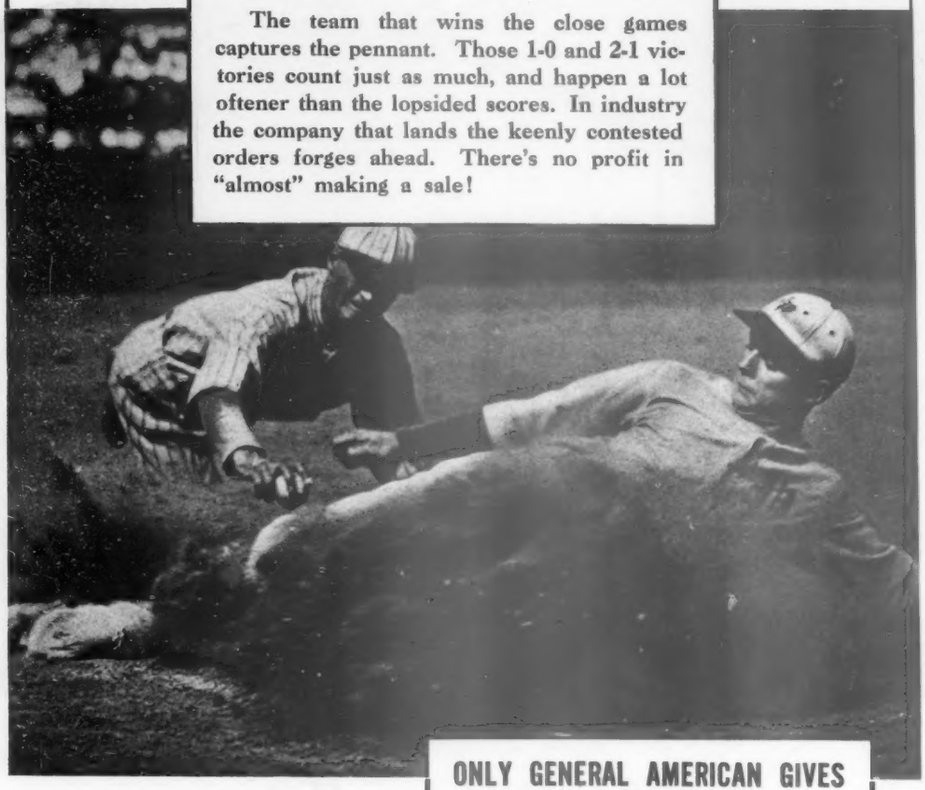

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a step in that direction, and inasmuch as we have dealt in this paper with effective stroke length, peak polished-rod load, and peak torque at the crankshaft, it seems well to show how these particular items vary with the aforementioned types of prime movers.

Although it is not practical to show all of the data from which these conclusions are drawn, there is a sufficient amount of positive proof to substantiate these observations:

1. Stroke length on a well using either beam or rotary counterweights to give practically equal power peaks on the up and downstroke is not affected appreciably by the type of prime mover.
2. Peak polished-rod loads, under the same conditions of counterbalancing, also are unaffected to any practical degree by the type of prime mover.
3. Peak torques on the crankshaft do vary with the prime mover, being greatest with the normal-slip motor. There was no observable difference in peak torque between the high-slip motor and the engine, unquestionably because both have speed-torque curves that result in appreciable speed drop with load increase and because of flywheel effect in the mechanical system.

Summary

Exhaustive test data showed the need for new formulas to calculate peak polished-rod load, effective plunger stroke, and crankshaft torque. These new formulas are shown herein, and the results from their use compared with those obtained from existing formulas and with actual test results.

Neither time for analysis nor space for presentation permits disclosure in this paper of all data that are of vital interest to the production branch of the industry; but there are in these existing test records, besides the data for developing a new formula already completed and presented in this paper, positive answers to many other perplexing problems incident to beam pumping of oil wells, from the pump to the prime mover. For example, there is evidence that there can be developed a method for determining more accurately prime-mover horsepower from the hydraulic horsepower, and that there can be determined the true relation between loads at the polished rod and at any point in the string.

The test analyses, therefore, continuously will go forward to achieve far-reaching results that will be recognized immediately as basic, beneficial, and important contributions to the production branch of the petroleum industry.

Bibliography

1. Formulas for peak crankshaft torque:

$$P = (W_r + W_o)\left[\frac{1 + (S\sqrt{SPM})}{5{,}400}\right]$$

given in A.P.I. Standards No. 11-E, entitled "A.P.I. Specifications for Rating of Pumping Machines."

2. Robert William Rieniets, "Plunger Travel of Oil-Well Pumps," Drilling and Production Practice, American Petroleum Institute, New York, 159 (1937).

3. Formulas for peak crankshaft torque:

$$0.4PS/2 \text{ or } (P - CB)\,S/2,$$

whichever is larger, given in A.P.I. Standards No. 11-E, entitled "A.P.I. Specifications for Rating of Pumping Machines."

Booklet on Thermodynamics Of Boiler Feeding

Descriptions of boiler-feed cycles in general, pumping power and mechanical problems with relation to feed-water temperature, analysis of temperature rise in boiler feed pumps, discussion of minimum permissible capacities, thermodynamic efficiency of boiler-feed pumps and the disposal of bypass and leakoffs, are contained in a booklet issuel by the Hydraulic Institute, "Thermodynamics of Boiler Feeding," by Igor J. Karassik.

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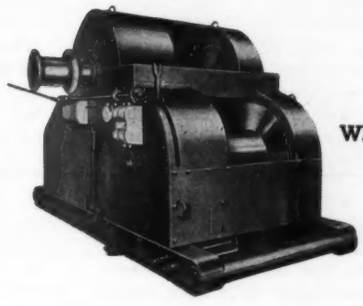
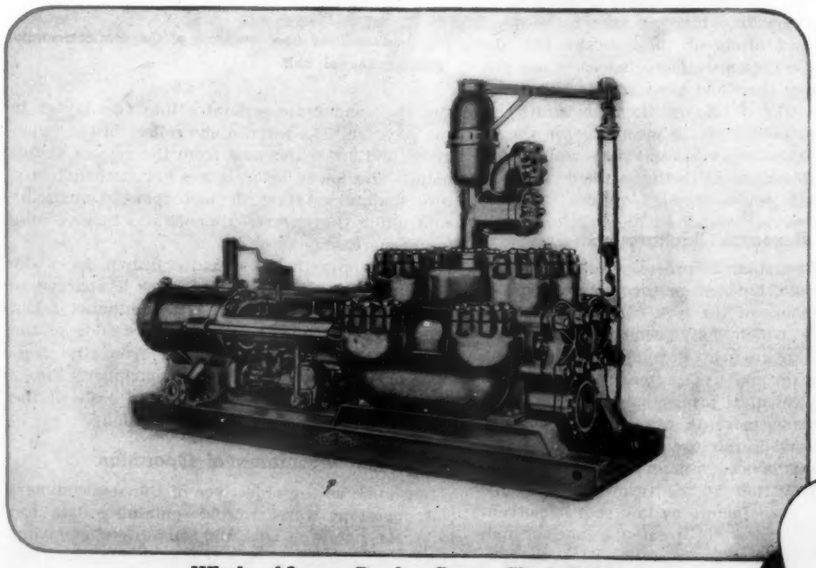
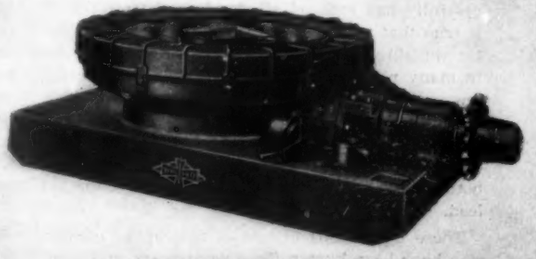


Wheland-Lucey Slim-Hole Drawworks



Wheland-Lucey Duplex Steam Slush Pump
H-20000-BA 16½" x 8" x 20"



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Diesel Mechanical Hook-ups	Oil Bath Swivels	Rotary Drilling Lines	Traveling Blocks
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Naphtha Treating Pays Its Way

By C. F. MASON, R. D. BENT, and J. H. McCULLOUGH
Atlantic Refining Co., Philadelphia, Pa.

A. P. I.

The caustic-methanol process removes essentialy all mercaptans from sour gasolines by extracting them with only 2 per cent of strong caustic and a suitable quantity of methanol. The spent reagent is regenerated by steam stripping and fractionation, and can be used indefinitely for mercaptan extraction.

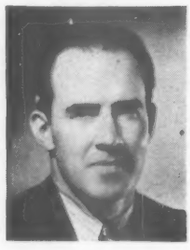
The paper presents pilot-plant studies of the extraction and regeneration steps. Data are given on reagent losses, utility consumption, control of the stability characteristics of the finished gasoline, and improvement in octane number and lead susceptibility over the untreated gasoline. The increase in leaded octane numbers of the treated products usually will offer an attractive saving in lead additions.

The process is ready for full-scale application. Several large plants are under way.

Paper presented before Division of Refining at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

C. F. MASON

R. D. BENT



J. H. McCULLOUGH

IN spite of the rapid and widespread "face lifting" which has taken place in refinery processing methods in the last decade, the naphtha-treating plant has undergone little basic change by the onslaught of new techniques and, in many plants, stands as an expensive citadel which successfully has resisted all development efforts. It is true that various schemes of regenerative caustic washing have eased the treating-cost burden in many places, but these have been only partial answers to the problem; and mercaptan conversion, by doctor treating or otherwise, continues as the predominating means of improving odor. Simultaneously, this same processing is harming both octane value and susceptibility to tetraethyl lead.

These deleterious effects of mercaptan conversion have been known for several years, and upon this realization came the pat and obvious answer—mercaptan removal. That much was easy, but how to do it was something else again. The mercaptans in the heavier parts of gasoline have objectionable odors, but are not sufficiently soluble in a cheap reagent such as aqueous caustic soda. Organic solvents, either alone or in caustic soda solution, tend to be excessively expensive, particularly if appreciable quantities are lost in the treated naphtha. Further, any solvent which removes mercaptans, of necessity, gradually will become fouled with sulfides, sulfates, thiosulfates, phenols, thiophenols, fatty acids, etc., unless some mechanism is provided for discharging these materials from the recirculation system without incurring excessive cost of reagent loss. This looks like a large order to expect any process to fill, but gasoline is a large-volume product of the refinery, and fractional unit savings in tetraethyl lead and octane level expand to large dollar returns and furnish incentive for extensive research and development work.

The caustic-methanol process, a development of the Atlantic Refining Co., meets the requirements imposed by the mercaptan-removal problem in an unusually satisfactory manner and, in addition, the commercialization of the process has disclosed that the unit manufacturing costs are considerably lower than had been anticipated at the beginning of the development. This gratifying fact increases the economic incentive for the installation of the process, and has resulted in large plant installations being pushed with all possible expedition.

Research Background

The caustic-methanol process was conceived some years ago, but was not commercialized at that time because of the lack of the large dollar driving force which has become apparent recently. The process in developed form has a research background of extensive studies of physical and chemical properties involving naphthas, mercaptans, solvents, and phenolic contaminants, alone and in mixture with aqueous caustic soda of various concentrations. The end product of this investigation is the result of economic evaluation of such factors as low cost of solvent components, low loss in treated naphtha, high solubility for mercaptans resulting in low recirculation rates, ease of separation of solvent components to permit ready control of recycle, contamination, and over-all flexibility with regard to source and types of naphthas which can be handled.

All of these data and studies will appear in the literature as occasion warrants. They have no place in the present discussion, as our object here is to examine the commercialized process which is the outcome of many months of operation of a semi-commercial plant on a variety of refinery naphthas at rates up to 300 bbl. per day.

The Semicommercial Unit

Upon reaching a decision that the research laboratory really had the germ of a good mercaptan-removal process in the caustic-methanol combination, the semiplant unit was erected in the naphtha-treating area of the refinery to permit ready access to large volumes of a variety of charging stocks. The nominal capacity of this plant was 50 bbl. per day, but in operation the rate has been varied from 15 bbl. to 300 bbl. per day in the course of pursuing the acquisition of data for use in full-scale design.

A simplified flow diagram of the plant is given in Fig. 1. Sour gasoline, essentially free of hydrogen sulfide, flows upward through a countercurrent extraction tower, packed with raschig rings. Regenerated caustic soda solution is pumped to the top of the tower and, in flowing down through the upper section, removes practically all of the methanol from the demercaptanized gasoline. Lower in the column, the methanol is introduced, and the combined solvents extract the mercaptans from the gasoline.

The spent reagent from the bottom of the extraction tower is pumped to a steam-stripping tower of conventional design. From the bottom of this tower, regenerated caustic is withdrawn and recycled to the top of the extraction tower. The overhead from the stripper—a mixture of methanol, mercaptans, and steam—is condensed,

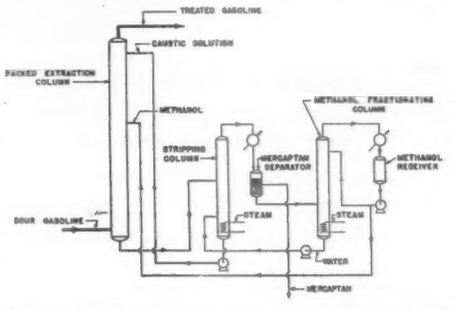


Fig. 1—Simplified flow diagram of the semicommercial caustic-methanol unit

and the condensate separates into two layers in the receiver. The mercaptans collect in the upper layer, and are withdrawn from the system at this point. The lower layer is a water-methanol mixture maintained low in mercaptan content by controlling the water-methanol ratio to give minimum mercaptan solubility.

The water-methanol mixture drawn from the bottom of the mercaptan separator is charged to the methanol fractionator. The methanol taken overhead is recycled to the middle section of the extractor. The water residuum from the fractionator recycles to the caustic stripper. Fig. 2 gives a general idea of the size and scale of the semicommercial plant under discussion.

Semicommercial Operation

Inasmuch as the objectives of the semicommercial operation were twofold—obtaining data for full-scale plant design, and obtaining operating costs and results on a variety of naphthas for economic justification—two distinct types of operation appeared in the program.

In one type of operation, four contact towers having cross-sectional areas of around 20, 27, 48, and 108 sq. in. were run to obtain extraction-tower-capacity data as well as to permit wide variations in the regenerator-section loads. In addition, packing size was varied to establish the

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optimum combination of tower size and packing size for any required design capacity. Similar basic design data have been established for the regeneration equipment. In the course of this phase of the program, an automatic control system applicable to plant design was successfully developed.

In the work which obtained data for economic justification of the process, more than 250 runs were made under a variety of conditions on numerous types of gasolines. Table 1 is illustrative

TABLE 1—SEMIPLANT EXTRACTION OF GRAY TREATED CRACKED GASOLINE

Operating conditions:		
Gasoline throughput	90	gal. per hour
Regenerated caustic	2.0	per cent by volume
Recovered methanol	0.8	per cent by volume
Treating temperature	100.0°	F.
Charge inspection:		
Gravity, °A.P.I.	58.1	
A.S.T.M. distillation, in deg. F.:		
Initial boiling point	98	
10-per cent point	146	
50-per cent point	248	
90-per cent point	372	
End point	422	
Reid vapor pressure, lb.	7	
Comparison of quality:	Sour gasoline	Treated gasoline
Total sulfur, per cent by weight	0.110	0.067
Mercaptan sulfur, per cent by weight	0.043	0.0005
Methanol, per cent by weight	....	0.004
Color (Saybolt)	24	25
A.S.T.M. octane number:		
Clear	71.9	71.9
Plus 1 ml. TEL*	76.4	77.9
Plus 2 ml. TEL	78.7	80.2
Plus 3 ml. TEL	80.3	81.8
Induction period, hours:†		
Clear	8.25	4.50
Plus recovered phenol	....	8
Plus 0.0025 per cent by weight of U.O.P. No. 4 inhibitor	....	8.50

*Tetraethyl lead.
†A.S.T.M. tentative "gum stability of gasolines."

of the type of information obtained. This particular one is a Gray processed cracked gasoline. It is noteworthy that this gasoline has a full boiling range (end point 422° F.), and yet the high capacity of the caustic-methanol reagent permitted excellent mercaptan removal with a recirculation rate of only 2.8 per cent by volume of total solvent based on the charge naphtha. For this reason, the regeneration equipment is small and relatively inexpensive, and steam and utility consumptions are low. This high mercaptan-carrying power of the caustic-methanol reagent is emphasized further when it is realized that the extraction side of the plant was operating at the normal treating temperature of 100° F.

A study of reagent loss is pertinent and illuminating, in that it throws into bold relief a feature of the caustic-methanol process which is outstanding. This feature is the separation of the two components of the reagent and the return of them separately to the system. In addition to other flexibility features which will be mentioned later, charging the regenerated caustic soda solution to the top of the extractor tower causes this section to function admirably as a methanol-recovery unit. As a result, the outlet gasoline contains only 0.004 per cent by weight of methanol. With methanol debited at 35 cents per gallon and gasoline credited at 5 cents per gallon, the methanol cost to the process is of the order of 0.05 cent per barrel of gasoline treated. There is no other significant loss of methanol.

As a further advantage accruing to the separation of the solvents during regeneration, the control of contaminants in the recycled reagents can be cited. Acidic materials, other than mercaptans, which tend to build up and foul the reagent can be kept in hand by the bleeding out of small quantities of caustic soda solution from the bottom of the stripper tower. This results in a caustic soda consumption similar to that encountered in current caustic washing practice. Extensive semiplant operation has shown that no foreign materials build up in the methanol and, hence, the methanol can be used indefinitely.

Plant-Equipment Considerations

In translating the knowledge gained from the semiplant experiences to full-plant design, several items are noteworthy. The extraction tower is a packed tower of conventional design; the various towers and drums on the regeneration side are equally unexciting from the design angle when the fundamental data pertinent to the process are at hand to work with. The moderate temperatures and pressures avoid the necessity for use of alloy steels, except for the tubes and tube sheets of the reboiler of the caustic-stripping

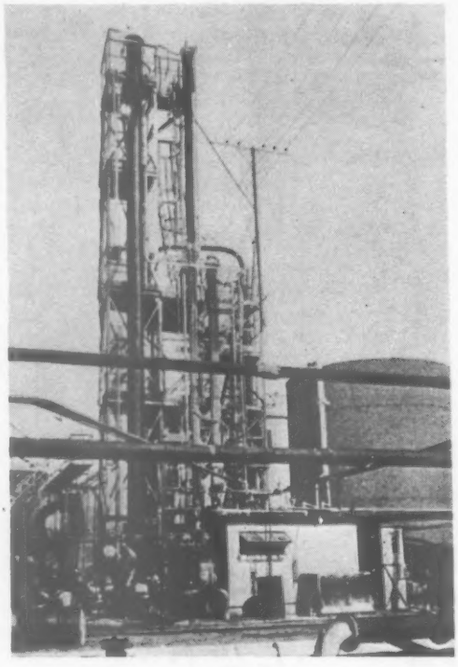

Fig. 2—The semicommercial unit

tower. Here, the materials commonly used by the chemical industry for handling boiler caustic soda solutions are indicated. These materials are nickel, nickel-clad steel, monel, special cast irons, etc. An interesting item in connection with the corrosion angle of the process is one which is indicative of the type of specialized knowledge obtained in the course of major developments, and which are always a valuable part of operating "know how." This is the indication that a buildup of sodium sulfide concentration in the reagent increases corrosion rates. Thus, it is recommended that hydrogen sulfide-free gasolines be treated, usually a simple matter to take care of in the refinery, using existing equipment.

Control of Gasoline-Stability Characteristics

Experience with a number of solvents teaches that any solution capable of extracting mercaptans also will extract, to some degree, any phenolic bodies present in the gasoline and, as a result, there will be a reduction in the oxidation-stability characteristics of the gasoline.

The caustic-methanol process offers considerable flexibility in handling gasolines of varying phenol contents. It will be recalled that, in the regeneration step, the methanol and mercaptans are distilled from the caustic soda solution. This regenerated caustic solution contains phenols and other acidic components extracted from the gasoline. If the stability characteristics of the gasoline being treated are such that the final product will be better because substantially all of the acidic bodies have been removed and because a synthetic inhibitor is used, the process can be controlled accordingly. This is accomplished by discarding a caustic solution rich in phenols (50 per cent by weight). The high ratio of phenol to caustic in this type of operation results in a low consumption of caustic soda.

If, on the other hand, the nature of the gasoline being treated permits the advantageous retention of the phenols, the process can be controlled to favor this retention. This is accomplished by permitting the phenols to build up in the recycled caustic soda solution. The carrying power of the reagent for mercaptans is not impaired by this buildup of phenolates, but the extraction of phenols from the gasoline notably is depressed.

In all cases, the susceptibility of the caustic-methanol-extracted gasolines to the action of synthetic oxidation inhibitors is excellent. In addition, the major portion of those phenols which are extracted is recovered as phenols from the methanol fractionation in the regeneration system at no additional operating cost. The return of these recovered phenols to the treated gasoline will reduce the synthetic-inhibitor requirements. In this connection, it is of interest to note that, in

TABLE 2—SEMIPLANT—RESULTS ON VARIOUS GASOLINE STOCKS

Gasoline stock—		Boiling range (°F.)	Total sulfur (Per cent by weight)	Mercaptan Sulfur (Per cent by weight)	Mercaptan removal (per cent)	A.S.T.M. octane number: Clear	Plus 1 ml. TEL	Plus 2 ml. TEL	Plus 3 ml. TEL	Reod vapor pressure (lb.)
1. Blend of polymer and high-sulfur cracked gasolines	Charge	96-390	0.190	0.0615	98.9	74.0	78.0	80.5	81.5	8.0
	Product	96-390	0.128	0.0007		74.0	80.0	82.2	83.8	7.5
2. High-sulfur cracked gasoline†	Charge	104-464	0.248	0.045	98.9	68.6	72.8	74.9	76.0	6.0
	Product	104-464	0.182	0.0005		68.8	73.6	75.9	76.9	5.7
3. Low-sulfur cracked gasoline	Charge	100-420	0.076	0.031	98.7	70.0	74.9	77.6	79.3	8.0
	Product	100-420	0.036	0.0004		70.2	76.6	78.9	81.1	8.0
4. West Texas straight-run gasoline†	Charge	85-290	0.076	0.035	98.9	69.2	75.4	79.4	...	17.4
	Product	85-290	0.041	0.0004		70.6	77.2	80.9	...	17.4
5. West Texas straight-run gasoline	Charge	90-345	0.119	0.062	98.9	68.5	75.2	78.0	...	14.1
	Product	90-345	0.056	0.0007		72.0	77.5	81.3		14.0
6. Mixed straightrun gasolines	Charge	120-360	0.056	0.008	96.3	62.5	70.1	74.7	78.2	5.0
	Product	120-360	0.049	0.0003		64.2	72.1	77.8	80.5	4.9
7. Hight-vapor-pressure blending stock*	Charge	.....	....	0.1300	99.6	62.0	70.1	73.6	...	...
	Product	.....	....	0.0005		62.0	72.6	78.0	...	...

*The charge stock in "7" was a 35-lb. Reid vapor pressure stock.
Octane numbers were obtained on blends of 25 per cent of this material in 75 per cent of low-sulfur mercaptan-free straightrun gasoline of the following inspection:

A.S.T.M. octane number:	
Clear	50.2
Plus 1 ml. TEL	63.2
Plus 2 ml. TEL	69.5

†The gasoline charge to these runs is a caustic-washed product; mercaptans partly removed.
Note.—All runs are same per cent by volume of "treat" and same operating temperature as in Table 1.

the case of the gasoline treated and reported in Table 1, the recovered phenols alone were able to restore the induction period to substantially its original value.

Economic Considerations

Table 2 tabulates the results of the semiplant treatment of a variety of different gasolines. In all these cases, the same volume per cent of recirculation of reagent (2.8 per cent) and treating temperature (100° F.) were used, and uniformly good mercaptan removal resulted. Clear octane numbers of the treated products were equal to or better than those of the sour stocks, which is noteworthy in view of the 0.25 to 1.0 number loss commonly encountered when the mercaptans are converted rather than extracted. Further, the increased susceptibility to tetraethyl lead offers an attractive lead saving in all cases.

The economics which require consideration for the evaluation of the caustic-methanol process in comparison to mercaptan-conversion processes are relatively simple. If, to the items mentioned previously, is added the fact that with the low reagent recirculation there is required only 10 lb. of steam per barrel of gasoline to accomplish reagent regeneration, it is not a burdensome task to add also reasonable figures for power, water, labor, etc. If this is done, a manufacturing cost of approximately 1.0 cent per barrel of naphtha, including reagent loss, is reached. From the standpoint of lead susceptibility and octane number, the previously mentioned data show that, in the average application, at least 0.25 ml. of tetraethyl lead per galion of gasoline can be taken as a credit and, in many cases, a considerably higher figure will be obtained.

From the plant-investment cost angle, precise figures are difficult to give, due to variations arising as a result of differences in capacities and local conditions. It is believed that, for a plant of reasonable size—say 5,000 bbl. per day—the investment will range from $2 to $12 per barrel per day.

What Price the Doctor Test?

The doctor test was originated to measure the completeness of the conversion of mercaptans to disulfides as carried out by the doctor-sweetening process. It always has been a test difficult to interpret, and border-line cases have caused almost endless bickering. It will be noted that doctor-test results in this discussion are conspicuously absent, and intentionally so.

The caustic-methanol process can produce gasoline "sweet to doctor," but it is pertinent to point out just how silly it would be to dwell on this ability. At various times during the experimental program the product from the caustic-methanol plant has run slightly "off doctor" for long periods of time, and yet the actual mercaptan content of the gasoline was lower than the "OK doctor" product from the doctor-treating plant running on the same stock and alongside of it! An interesting side comment is that certain critical noses in the organization express a preference for the odor of the "extracted" to the "converted" product—so that, apparently, the disulfides are not as odorless as we have grown to believe.

The caustic-methanol process is offered for your consideration as a mercaptan-removal process furnishing all the benefits that accrue from substantially complete removal of mercaptans from gasoline. Although the "doctor" can be met, we insist on gaging the efficiency of mercaptan removal by measuring the residual mercaptan in the treated gasoline.

Acknowledgment

Acknowledgment gratefully is made to the technical personnel of the Universal Oil Products Co. of Chicago, Ill., for assistance in the preparation of this discussion. This company is the licensing agent for the process under U. S. Patents 1968842, 1968843, and 2043254, and pending applications.

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DIFFERENCE BETWEEN SLOW AND RETARDED SET. Normal portland cement begins to stiffen when water is added, continues to stiffen thereafter, and does so at a much faster rate when temperature increases. Slow-setting cement stiffens similarly but at a slower rate. But Unaflo has a *retarded* set, and does not congeal but remains fluid and pumpable for the entire period of retardation, after which it hardens normally. It does not stiffen, or jell, but remains fluid under different hole temperatures and pressures during the period required for pumping, including unforeseen delays and shutdowns for extended periods.

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1. **Permits placement of slurry while still fluid;**
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3. **Minimizes the hazard of sticking the pipe;**
4. **Provides a safer cement for various cementing operations, including deep, tough jobs.**

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with the retarded set, provides and pumpable for extended temperatures and pressures

17-lb. slurries. These have several advantages. For example, a heavy Unaflo slurry that remains fluid and pumpable—

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2. **Flushes ahead of it the lighter, rotary mud without breaking the mud seal;**
3. **Does not become contaminated with the mud;**
4. **Produces back of the casing a more continuous body of good cement;**
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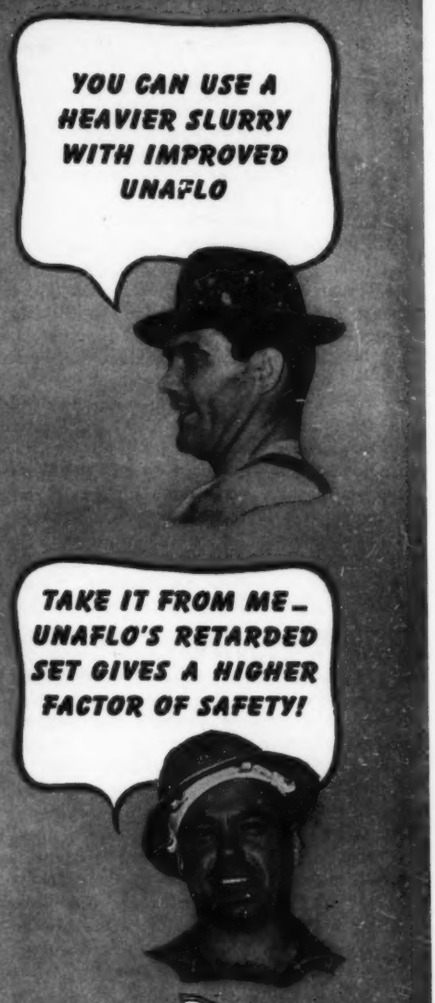
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Experiences With and the Effect of Use of Scrapers On Internal Corrosion of Gasoline Pipe Lines

By D. E. SULLIVAN
Pure Oil Co., Chicago, Ill.

IN the early 1930's, when the construction of the vast network of gasoline pipe lines in the United States was just beginning, the problem of interior corrosion of gasoline pipe lines was not seriously anticipated. After their initial operation, these earlier gasoline pipe lines began to show a rapid increase in the friction of flow, with the consequent impairment of their throughput capacity. The cause of this decline immediately was recognized as interior corrosion. In some cases it was so serious that the products of corrosion building up in sharp bends in the line or around the interior recesses of valves completely plugged the lines and shut off the flow. In other cases, the products of corrosion built up barnacle-like structures, which adhered to the inside of the pipe and caused the interior surfaces to become rough and resistant to the smooth flow of the gasoline. Finding the definite cause of the corrosion and a simple remedy for the loss in capacity was not an immediate development. Ultimately, however, almost all authorities agreed that the basic cause of the trouble was the adherence to the inside periphery of the pipe of "hungry" water that is precipitated out of ordinary gasoline when the temperature of the gasoline is lowered. At this point it became apparent that some means of removing both the water and the products of corrosion from the lines must be devised.

There is nothing fundamentally new about the use of scrapers or "go-devils" in connection with the operation and maintenance of pipe lines. For many years scrapers have been used in water pipe lines for removing tubercles, and in crude-oil lines for removing paraffin and other obstructions to smooth flow that may be built up on the inside walls of the pipe. For these purposes the old conventional-type scraper (see Fig. 1) always

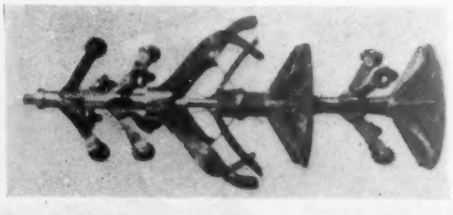


Fig. 1—Conventional-type scraper used on crude-oil and water pipe lines

has been used. The cutter wheels on the front serve to loosen the deposits and to make it easier for the scraper fins and leather disks to remove the deposits and carry them onward. The scraper fins are arranged so that the whole device is caused to rotate as it advances through the line. In water lines and and crude-oil lines the materials removed are of such a nature that, of themselves, they serve as a lubricant for the many moving parts of scrapers of this type. Another useful feature of this type scraper is that the many loose parts create considerable noise as the scraper advances and, consequently, it is easy for a line walker to follow the scraper without losing track of its location.

Scrapers of this type were found to be definitely not satisfactory for gasoline pipe-line service. Gasoline, or any of the materials that have to be removed from a gasoline pipe line, is not a good lubricant, and particles of scale and powdered iron oxide have a tendency to "freeze" and jam the bearing surfaces. As a result of this it has been found that, when the old or conventional-type scraper is used in gasoline pipe lines, many or all of the small parts will break off and remain behind the scraper in valve recesses and other places where they serve as obstructions to the passage of future scrapers. The ultimate removal of these small parts from the line is difficult. Also, due to lack of lubrication, the leather disks wear out rapidly and cause the scraper to lose its effectiveness in pushing water ahead of it.

Through an extended process of designing and trying out scrapers of various types, some of the gasoline pipe-line operators have obtained the best results with a short plug-like scraper made up of a series of natural-rubber disks and circular wire brushes. The wire brushes serve to scrape the products of corrosion free from the walls of the pipe, and the squeegee effect of the rubber tends to wipe off the water which adheres to the pipe wall. The advantage of natural rubber over synthetic materials for the disks lies in the expansion of the natural rubber in contact with the gasoline. This expansion of the material serves to replace any rubber worn off by erosion, and at the same time causes the contact to become tighter, with consequent improvement in the squeegee effect as the scraper advances.

Figs. 2 and 3 show an assembled and unassembled view of a 6-in. scraper of the aforementioned type, which has been used successfully. The main

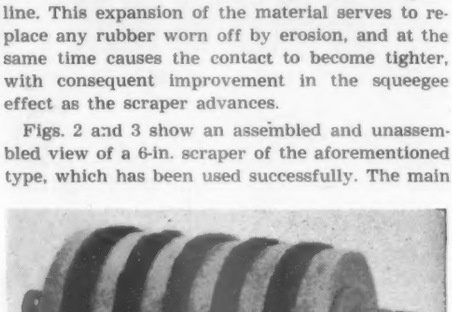


Fig 2—"Rubber squeegee and wire brush" type scraper assembled

stem of the scraper is a piece of 1-in. double extra-strong pipe, 14 in. long, machined to an outside diameter of 1.25 in., plugged at both ends, threaded on one end for the 1¼-in. nuts, with the other end equipped with a ¼ by ¼-in.-diameter steel disk welded fast. The five wire brushes that are threaded in the stem between the rubber disks are double-knot wire-brush wheels, 6¼ in.

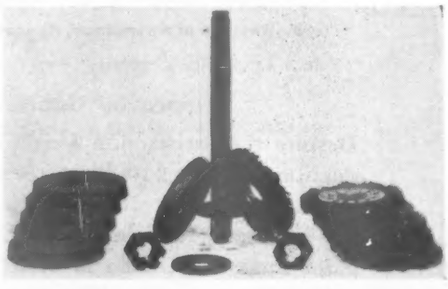
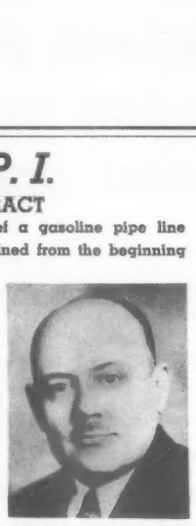


Fig. 3—"Rubber squeegee and wire brush" type scraper unassembled

in diameter and 1 in. thick, with a 1¼-in. hole through the center. The wire is 0.014-in. piano wire. These brushes can be purchased from any one of a number of supply houses. The rubber disks are made of a natural-rubber compound which is partly soluble in gasoline, and which will expand in volume about 25 to 50 per cent when immersed in gasoline for a period of about 12 hours. It has been the experience of one company that one of these scrapers can be used for a total distance of about 120 miles in gasoline before the rubbers and brushes become so badly worn that they are not serviceable for future use. Fig. 4 shows the worn appearance of one of these scrapers after it had been cleaned up after a total travel of 80 miles. The ridges shown in the rubbers in this illustration are due to the cutting action of "icicles" that still remained on the inside of the line. However, due to the swelling of the rubber in contact with gasoline, these ridges are not sufficient to impair the squeegee effect of the rubbers in removing water from the inside of the pipe. It is recommended that these scrapers be used in pairs, the two scrapers being inserted

A. P. I.

ABSTRACT



The original capacity of a gasoline pipe line can be restored or maintained from the beginning of its operation if scrapers of the "wire brush and rubber squeegee" type are run through the line at uniform intervals of every 3 or 4 days. Whether this process increases the rate of interior corrosion by constantly exposing fresh surfaces to new attacks or whether persistent and frequent removal of water by the scraper causes abatement of the corrosion rate has not been proved.

Paper presented before Division of Production at the annual meeting of the American Petroleum Institute, San Francisco, Calif., Nov. 3-7, 1941.

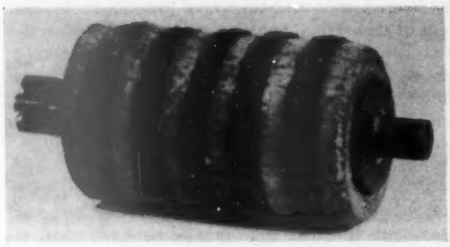


Fig. 4—"Rubber squeegee and wire brush" type scraper after having traveled 80 miles through 6-in. pipe

in the line about 15 to 20 minutes apart. Fig. 5 shows a method of pushing the scraper into the line with a railroad jack, and Fig. 6 shows the scraper being removed from the line at the end of its journey.

It is also recommended that a slop tank large enough to hold the entire throughput of the pipe line for about a 15 to 20-minute period be installed at each scraper pit, where scrapers are removed from the line. This tank should be used to receive the water and debris that come to the pit during the approximate 5-minute period before the scraper arrives and the approximate 10-minute period after it has arrived in the scraper spool. It has been found that this period is long enough to collect most of the debris that comes through with the scraper, and serves to prevent the deposition of this debris in the booster strainers or delivery tanks.

The Detroit Southern pipe line is a 6-in. line 80 miles long, which transports and keeps separate seven different grades of gasoline and two grades of furnace oil from the Toledo, Ohio, refining area to a distribution terminal in Hamtramck, Mich., near the geographic center of the city of Detroit. The first 40 miles of this line are of A.P.I. Grade B seamless tubing, and the balance is of A.P.I. Grade A seamless tubing. All of it is of a standard weight, with an inside diameter of 6.065 in. This pipe line was constructed in 1933, and began operation in September 1933.

When the pipe line was built, provision was made for using scrapers; and during the first year of operation the old or conventional-type scrapers with leather disks were run on perhaps two occasions. These were mainly for the purpose of knocking off "icicles" and for removing other debris that might have been left in the line during its construction.

At the end of the first year of operation it was

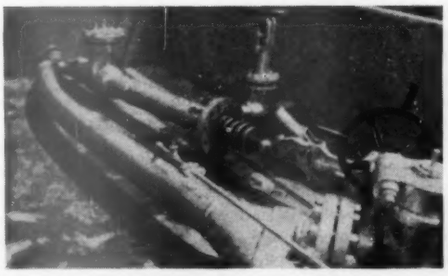


Fig. 5—Pushing "rubber squeegee and wire brush" type scraper into 6-in. pipe line with railroad jack

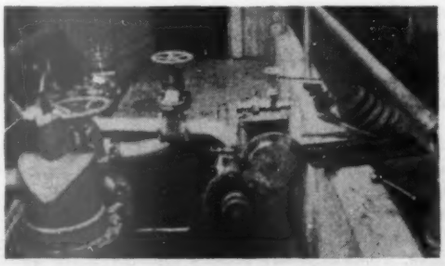


Fig. 6—"Rubber squeegee and wire brush" type scraper being removed from 6-in. pipe line

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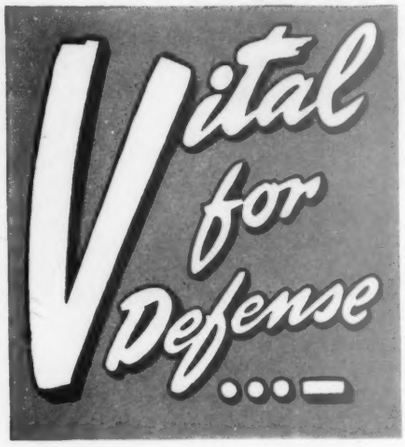

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discovered that the line had lost about 11 per cent of its original capacity, and that this capacity was continuing to decline. During the next 3 months, six of the old conventional-type scrapers were run. This resulted in a gain of 2 or 3 per cent in the line capacity, but the running of these scrapers was accompanied by many difficulties. The scrapers would break apart in the line due to lack of lubrication, and the quantity of scale and debris ahead of the scrapers would jam and cause the line to plug. It was believed that, if the line could be thoroughly cleaned out once and then kept clean, the capacity-loss problem could be solved.

After months of trial and error in an effort to find a satisfactory scraper for accomplishing this, a scraper of the type shown in Figs. 2, 3, and 4 was developed. At the end of the second year of operation the solution of the problem became apparent, and a scraper campaign for recovery of the lost capacity was begun.

Fig. 7 is a chart which shows the loss in capacity that was suffered by the Detroit Southern pipe line, as a result of interior corrosion, during the first 2 years of its operation, and the recovery of this lost capacity that was effected by the use of scrapers. The capacity graph on this chart was calculated from quarterly average of the daily operating reports showing the total friction pressure required by the particular throughput used. The original capacity available when the pipe was new was considered to be 100 per cent. The original C value, as calculated from the Williams and Hazens formula, was 143.4. During the first 2½ years of operation, the capacity declined to about 74 per cent of the original capacity, and the C value was lowered to 110.2. The chart clearly shows that, as the frequency of scraper runs was increased, the line capacity was improved. At this writing the line is operating at a rate higher than its original capacity. It is now the regular practice to run scrapers through the line at not more than 4-day intervals.

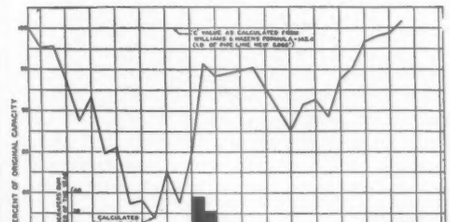
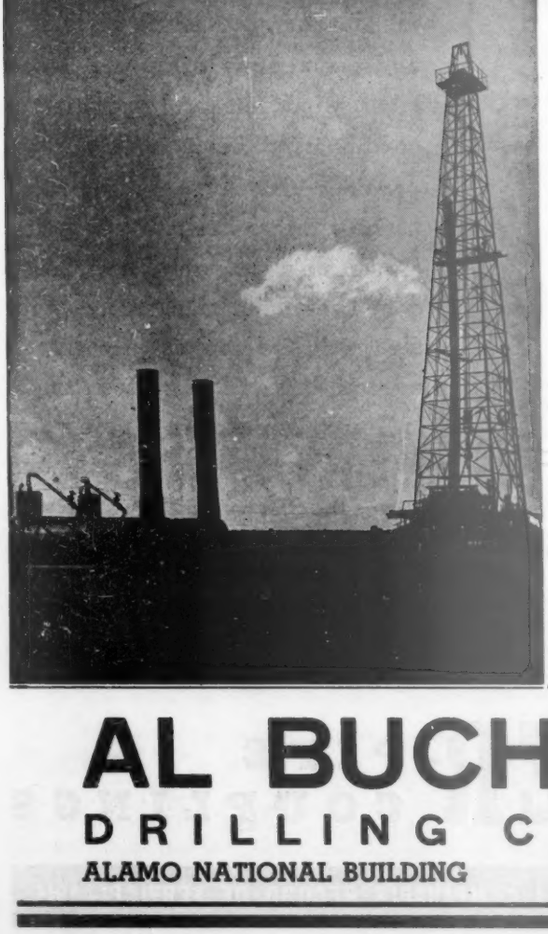


Fig. 7—Graph showing effect of use of pipe line scraper upon throughput capacity of Detroit Southern Pipe Line

Conclusion

The conclusion reached from this is that the original capacity of a gasoline pipe line can be restored or maintained from the beginning of its operation, if scrapers of the "wire brush and rubber squeegee" type are run through the line at uniform intervals of every 3 or 4 days. Not more than 4 days should elapse between running of scrapers, because a greater time permits the accumulation of so much scale and debris that the scraper may pile up the material ahead of it and plug the line. Running the scrapers at these frequent intervals makes possible the smooth and continuous movement of the scraper without interruption. Whether this process has any effect upon the actual rate of interior corrosion has not been proved. Some engineers believe that the scrapers increase the rate of interior corrosion by constantly exposing fresh surfaces to new attacks, whereas others believe that persistent and frequent removal of the water causes abatement of the corrosion rate.



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Progress Report on the

Hydrocarbons in the Kerosene Fraction of Petroleum

(A.P.I. RESEARCH PROJECT NO. 6*)

By FREDERICK D. ROSSINI† and BEVERIDGE J. MAIR‡

IN previous reports on A.P.I. Research Project 6, there have been described the results of the work on the gasoline and the lubricant fractions of the crude petroleum under investigation. The work on the gasoline fraction to date has resulted in the isolation and identification of 49 hydrocarbons of the range from C_5 to C_{10}, and has provided quantitative data as to their relative amounts. As this number of hydrocarbons has been found to constitute somewhat over half of the gasoline fraction, it appears that, from a practical standpoint, the gasoline fraction at least is less complex than had been supposed originally. In the work on the gasoline fraction, the project has developed special techniques and methods of separation, a number of which have been found useful by the research, development, and testing laboratories in the industry.

The work on the lubricant fraction, on the other hand, has substantiated beliefs as to the complexity of the material. In this work, new methods had to be developed to meet the increased difficulties of the separations involved. However, no pure hydrocarbons were isolated. Instead, there were obtained a series of fractions of sufficient homogeneity (with respect to size and type of molecules) to permit fairly definite conclusions to be drawn as to their general molecular structures. As sufficient data on the properties of pure hydrocarbons of the lubricant range are not yet available for the complete identification of the fractions which would be obtained on further resolution of the lubricant fraction, the advisory committee agreed with the staff of Project 6 that it would be best to hold further work on the lubricant fraction in abeyance until more data on pure hydrocarbons of high molecular weight became available from API Research Project 42 and other sources.

In 1938 the project began the investigation of the kerosene fraction. In some respects, this study holds promise of results even more interesting than those already reported on the gasoline and lubricant fractions. In the kerosene fraction, the number of carbon atoms in the molecule is large enough to permit of a wide variety of molecular structures. At the same time, our newly developed methods of separation are succeeding in the isolation of the more abundant of these difficultly separable hydrocarbons. It is hoped that this study on the kerosene fraction will throw considerable light on the relative abundance of the different types of hydrocarbons in the gas-oil and even in the lubricant fraction.

The work on the gasoline fraction already has shown that the more abundant isoparaffins are those less highly branched; that naphthenes with both five and six-membered rings occur in important amounts; and that aromatic hydrocarbons with ethyl and propyl groups are present to a greater extent than in coal tar, our hitherto most important source of aromatics. Questions such as the following cannot be answered from the results on the gasoline fraction because of the insufficient number of carbon atoms per molecule, but should be answered by the work on the kerosene fraction:

1. Do compounds containing both cyclopentane and cyclohexane rings in the same molecule occur in petroleum?

2. Do compounds in which rings are linked through a single carbon atom occur?

3. Do compounds occur which contain an aromatic ring linked through two common carbon atoms to a cyclopentane ring, as in indane and its homologs?

4. How do the amounts of the normal and isoparaffins change as one passes from the gasoline to the kerosene and higher-boiling fractions?

5. The work on the lubricant fraction indicated that there were in it no significant amounts of isoparaffins.[1,2] Where, and how sharply, does the content of isoparaffins drop to this low value, as one passes from the gasoline to the lubricant fraction?

This paper represents the first progress report to the American Petroleum Institute on the investigation of the kerosene fraction of petroleum by its Research Project 6. The starting material was that portion of the petroleum* boiling in the range of 200° to 230° C. (392° to 446° F.) at a pressure of 1 atmosphere. These particular limits were set primarily because they encompass only one normal paraffin hydrocarbon, viz., *n*-dodecane, which normally boils at 216° C. The two neighboring normal paraffins, *n*-undecane and *n*-tridecane, normally boil at 196° and 236° C., respectively.

The material of the range 200° to 230° C. at 1 atmosphere† to date has been separated completely into three lots: (1) one lot consisting substantially of all of the normal paraffin, *n*-dodecane; (2) one lot of fractions consisting substantially of all of the aromatic hydrocarbons; and, (3) one lot of fractions consisting of mixtures of the branched-chain or isoparaffins and the naphthenes or cycloparaffins. Seven aromatic hydrocarbons have been isolated and identified from Lot 2.

A. P. I.

In the progress report from A.P.I. Research Project 6, on that part of its work dealing with the isolation and identification of hydrocarbons in the kerosene fraction of petroleum, the following topics are discussed: present status of the work on the gasoline and kerosene fractions; outline of the separation of the kerosene fraction; properties of the hydrocarbons isolated; other hydrocarbons likely to be separated; amounts of the hydrocarbons in the kerosene fraction and in the original crude petroleum; significance of the work to the petroleum industry.

Paper presented before Division of Refining at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

*For a description of this petroleum, which was from the Mid-Continent field, see References 1 and 2 in the bibliography.

†In the laboratory, the simple distillation of the material actually is performed at a pressure of 57 mm. mercury, with a consequent lowering of temperature of about 86° C.

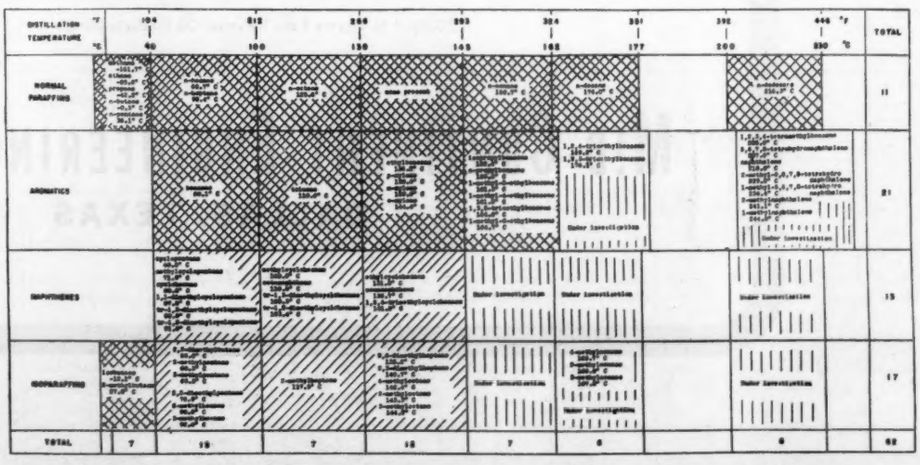
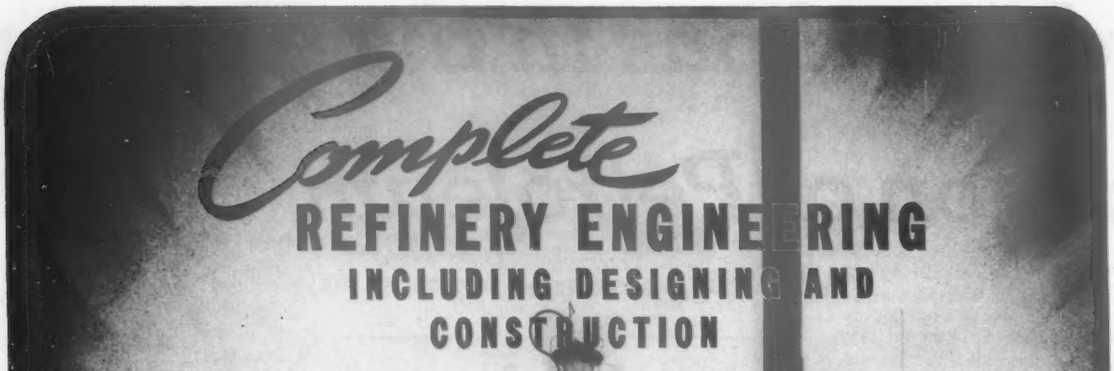


Fig. 1—Status of the analysis of hydrocarbons in the gasoline and kerosene fractions of petroleum by A.P.I. Research Project 6 at the National Bureau of Standards, as of September 1941

*Presented by J. Bennett Hill, Sun Oil Co., chairman, advisory committee, A.P.I. Research Project 6.
†National Bureau of Standards, Washington, D. C.; director, A.P.I. Research Project 6.
‡Senior research associate, A.P.I. Research Project 6, at the National Bureau of Standards.



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The current work consists in the separation of additional aromatic hydrocarbons from Lot 2, and the separation of the fractions of Lot 3 into isoparaffins on the one hand and naphthenes on the other. When the isoparaffins and the naphthenes sufficiently well are segregated by class, the separation of pure hydrocarbon compounds from them will begin.

Present Status of the Work on the Gasoline and Kerosene Fractions

For the purpose of orientation, there is shown in Fig. 1 the present status of the investigation of the hydrocarbons in the gasoline and kerosene fractions by A.P.I. Research Project 6, as of September 1941. The nonuniform horizontal scale at the top of the chart gives the distillation temperature in °C. and °F. On the margin at the left, the material is shown divided into four classes: normal paraffins, aromatics, naphthenes or cycloparaffins, and branched-chain or isoparaffins. The distillation temperatures are divided substantially according to the way in which the material actually was investigated. The row at the bottom gives the number of hydrocarbons isolated from the various portions. The column at the extreme right gives the number of isolated hydrocarbons of the four classes. The block at the lower right corner of the chart gives the total number of hydrocarbons so far determined in the gasoline and kerosene fractions. Under the name of each hydrocarbon appears its boiling point at 1 atmosphere in °C. The displacement to the right of the blocks showing the aromatic hydrocarbons arises from the fact that, in the distillation of the original mixture of hydrocarbons, the aromatic hydrocarbons usually appear in the distillate with normally lower-boiling hydrocarbons of the other classes. The doubly crosshatched blocks indicate those portions in which all of the theoretically possible hydrocarbons have been determined. The singly crosshatched blocks indicate those portions whose analysis is considered substantially complete even though only a few of the possible hydrocarbons have been actually isolated from them. The portions under investigation at the present time are so marked, and are shown with vertical lines. The material distilling in the range 177° to 200° C. has not yet been investigated at all.

From this chart, the relation of the work on the kerosene fraction to the work on the gasoline fraction is evident. In what follows, there is given a more detailed account of the work on the kerosene fraction and some discussion of its significance to the petroleum industry.

Outline of the Separation of the Kerosene Fraction

A schematic diagram outlining the separation of the kerosene fraction[3, 4] into: (1) the normal paraffin; (2) the fractions of aromatic hydrocarbons; and, (3) the fractions consisting of mixtures of isoparaffins and naphthenes, is shown in Fig. 2.

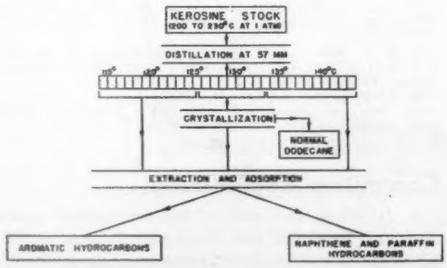


Fig. 2—Schematic diagram showing the separation of the kerosene fraction, 200° to 230° C.

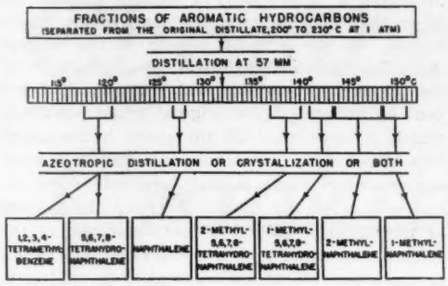


Fig. 3—Schematic diagram showing the isolation of seven hydrocarbons from the aromatic portion of the kerosene fraction

Fig. 3 shows a schematic diagram outlining the separation of seven hydrocarbons from the aromatic fractions.[3, 4] The isolation of additional hydrocarbons from this material is under way.

Fig. 4 shows a schematic diagram outlining the separation of the isoparaffins from the naphthenes. As indicated, the material of the range 200° to 220° C. (at 1 atmosphere) is being separated by

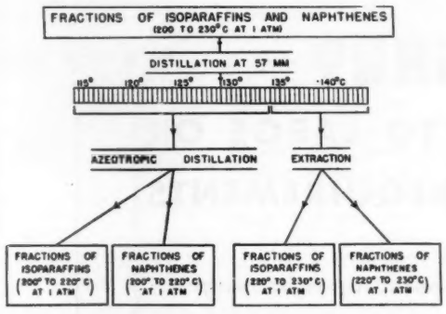

FRACTIONS OF ISOPARAFFINS AND NAPHTHENES
(200 TO 230°C AT 1 ATM)
DISTILLATION AT 57 MM
AZEOTROPIC DISTILLATION
EXTRACTION
FRACTIONS OF ISOPARAFFINS (200° TO 220° C) AT 1 ATM
FRACTIONS OF NAPHTHENES (200° TO 220° C) AT 1 ATM
FRACTIONS OF ISOPARAFFINS (220° TO 230° C) AT 1 ATM
FRACTIONS OF NAPHTHENES (220° TO 230° C) AT 1 ATM

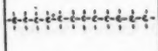
Fig. 4—Schematic diagram showing the separation of the isoparaffins from the naphthenes

azeotropic distillation, whereas the material of the range 220° to 230° C. (at 1 atmosphere) is being separated by extraction. This azeotropic distillation[5] is being performed at a pressure of 770 mm. mercury with diethylene glycol monomethyl ether as the azeotrope-forming substance. The extraction is being performed at about 10° C., with methyl formate as the solvent, in 56-ft. columns operating with reflux. These two different methods deliberately are being used in order to develop the technique and to make a comparison of the overall efficiency of the two. When the separation of the isoparaffins from the naphthenes substantially is completed, the separation of pure isoparaffin compounds and pure naphthene compounds will begin.

Properties of the Hydrocarbons Isolated

In Table 1 are listed the eight hydrocarbons isolated from the kerosene fraction, with their properties as determined at the National Bureau of Standards.[3, 4] For each hydrocarbon there is given the amount of impurity in the "best" lot of it isolated from petroleum. The values of the properties reported have been corrected to zero impurity, and are believed to be the values of the properties for the absolutely pure hydrocarbons within the limits indicated. Actually, with the exception of 5,6,7,8-tetrahydronaphthalene, tetralin, in which the amount of impurity was 0.015 mole fraction, the "best" lots of these hydrocarbons were so pure that there was no significant change in the values of the properties on extrapolation to zero impurity. Without exception, each of the "best" lots of these eight hydrocarbons from petroleum was, as far as is known to the authors, purer than any lots of the same hydrocarbons previously prepared, synthetically or otherwise. Following the established procedure in the work of Project 6, the freezing points and amounts of impurity in these hydrocarbons were determined from time-temperature freezing and melting curves.[6] The boiling points were deter-

TABLE 1—PROPERTIES OF HYDROCARBONS ISOLATED FROM THE KEROSENE FRACTION
(Values of properties are extrapolated to zero impurity)

Name	Formula	Structure (conventional) (hydrogen atoms omitted)	Amount of impurity in "best" lot from petroleum	Boiling point at 1 atm	Freezing point in air at 1 atm	Density at 20°C	Density at 25°C	Refractive Index N_D at 20°C	Refractive Index N_D at 25°C	Specific Dispersion $(N_D-N_C)/d$ at 20°C	Specific Dispersion $(N_D-N_C)/d$ at 25°C
1,2,3,4-Tetramethylbenzene (prehnitene)	$C_{10}H_{14}$		0.0006 ±0.0001	205.04 ±0.03	-6.25 ±0.01	0.9053 ±0.0001	0.9015 ±0.0001	1.52013 ±0.00007	1.51811 ±0.00007	0.01739 ±0.00045	0.01732 ±0.00045
5,6,7,8-Tetrahydronaphthalene (tetralin)	$C_{10}H_{12}$		0.015 ±0.002	207.57 ±0.10	-35.80 ±0.02	0.9702 ±0.0002	0.9662 ±0.0002	1.54135 ±0.00015	1.53919 ±0.00015	0.01665 ±0.00010	0.01655 ±0.00010
n-dodecane	$C_{12}H_{26}$		0.0000 ±0.0006	216.26 ±0.03	-9.57 ±0.01		0.74512 ±0.00015		1.41851 ±0.00010		0.00784 ±0.00010
naphthalene	$C_{10}H_8$		0.0046 ±0.0004	217.96 ±0.03	80.27 ±0.02		(at 95°C) 0.9752 ±0.0002		(at 85°C) 1.5918 ±0.0002		(at 85°C) 0.0297 ±0.0002
2-methyl-5,6,7,8-Tetrahydronaphthalene (β-methyltetralin)	$C_{11}H_{16}$		0.0046 ±0.0007	229.03 ±0.03	-39.25 ±0.03	0.9537 ±0.0002	0.9500 ±0.0002	1.53572 ±0.00010	1.53365 ±0.00010	0.01648 ±0.00005	0.01642 ±0.00005
1-methyl-5,6,7,8-Tetrahydronaphthalene (α-methyltetralin)	$C_{11}H_{16}$		0.029 ±0.004	234.35 ±0.05	-22.90 ±0.03	0.9720 ±0.0002	0.9683 ±0.0002	1.54395 ±0.00010	1.54190 ±0.00010	0.01645 ±0.00005	0.01639 ±0.00005
2-methylnaphthalene (β-methylnaphthalene)	$C_{11}H_{10}$		0.0060 ±0.0003	241.19 ±0.05	34.49 ±0.02		(at 40°C) 0.99695 ±0.00005		(at 40°C) 1.60152 ±0.00010		(at 40°C) 0.02927 ±0.00010
1-methylnaphthalene (α-methylnaphthalene)	$C_{11}H_{10}$		0.0025 ±0.0011	244.78 ±0.10	-30.77 ±0.04		1.0163 ±0.0001		1.61944 ±0.00010		0.02947 ±0.00010

mined in a recently constructed apparatus with a platinum resistance thermometer.[7] The refractive indices were determined, for monochromatic light of the *D* line of sodium and the *F* and *C* lines of hydrogen, in the optical instruments section, and the densities in the capacity and density section, at the National Bureau of Standards.

Amounts of Hydrocarbons in the Kerosene Fraction and in the Original Petroleum

After the distillate of the range 200° to 230° C. had been separated as shown in Fig. 2, the material was distributed as follows:

Lot	Material—	Per cent by volume of the distillate 200° to 230° C.
1	Normal paraffin	13.6
2	Aromatic hydrocarbons	19.1
3	Isoparaffins and naphthenes	67.3
	Total	100

The processing has not yet reached the stage where an accurate value can be given for the relative amounts of the isoparaffins and naphthenes. Of the eight individual hydrocarbons actually isolated, the amounts in the petroleum are estimated to be as shown in Table 2, wherein are given the following data: the name of the hydrocarbon, the per cent by volume of the original distillate, 200° to 230° C., which is constituted by the given hydrocarbon; and the estimated per cent by volume of the original crude petroleum which is constituted by the given hydrocarbon. The values in the last column are subject to some change when there become available more accurate data on the relation between the volume of the distillate 200° to 230° C. and that of the original petroleum from which it came. The values in the other column are believed to be subject to no change beyond the assigned uncertainties.

From the values presented here, the following points may be noted with regard to the distillate 200° to 230° C.:

a. All of the normal paraffin and 30 per cent of the aromatic portion have been resolved with respect to pure compounds. The total resolved material represents about 20 per cent of the distillate 200° to 230° C.

b. There remains to be resolved 70 per cent of the aromatic portion and all of the portion containing the isoparaffins and naphthenes. The total unresolved material represents about 80 per cent of the distillate of the range 200 to 230° C.

c. There is a more or less regular relation in the relative abundance of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, and of their partly hydrogenated derivatives, 5,6,7,8-tetrahydronaphthalene, 1-methyl-5,6,7,8-tetrahydronaphthalene and 2-methyl-5,6,7,8-tetrahydronaphthalene.

TABLE 2—AMOUNTS OF THE HYDROCARBONS IN THE KERESENE FRACTION AND IN THE ORIGINAL PETROLEUM

	Amount constituted by the given hydrocarbon	
Hydrocarbon—	Per cent by volume of the distillate 200° to 230° C.	Estimated per cent by volume of the original crude petroleum
n-Dodecane	13.6 ± 0.8	1.0
1,2,3,4-Tetramethylbenzene	1.06 ± 0.07	0.078
5,6,7,8-Tetrahydronaphthalene	0.27 ± 0.03	0.020
1-Methyl-5,6,7,8-tetrahydronaphthalene	0.65 ± 0.12	0.048
2-Methyl-5,6,7,8-tetrahydronaphthalene	0.68 ± 0.06	0.050
Naphthalene	0.46 ± 0.04	0.034
1-Methylnaphthalene	0.84 ± 0.06	0.062
2-Methylnaphthalene	1.80 ± 0.10	0.132
Total	19.4 ± 0.8	1.4

Discussion

It may well be that the analysis of the kerosene and other fractions below the lubricant fraction, because they are less complex, will yield more information with less effort about the composition of the lubricant fraction than a direct attack on the lubricant fraction itself. Already valuable information along these lines has been obtained. Thus the presence in the kerosene fraction of tetrahydronaphthalene and its homologs is consistent with the previous finding that the lubricant fraction contains compounds in which both aromatic and naphthene rings occur in the same molecule. Similarly, it had been shown previously that in the lubricant fraction those molecules containing two aromatic rings were in large part ones in which these aromatic rings were linked together through two carbon atoms, as in naphthalene and its homologs.[8] As previously reported, these latter compounds have been isolated already from the kerosene fraction.

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Committee Appointment

A. L. Wiest, manager of the lubricants department of Shell Oil Co., Inc., San Francisco, has been appointed to the lubrication committee of the American Petroleum Institute Division of Marketing.

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Reaction Chambers on Thermal-Cracking Units

By R. C. MITHOFF and L. F. SCHIMANSKY
Standard Oil Co. of California, San Francisco, Calif.

THERMAL-CRACKING units employed by Standard Oil Co. of California about 10 years ago were equipped with primary flash chambers or evaporators. The top transfer oil from the furnace was discharged, without quenching, into the evaporator wherein the vapor and liquid were separated. The overhead vapor passed directly to the fractionating column. Sufficient liquid was maintained in the evaporator to seal the bottom draw. The heavy liquid oil from the evaporator bottom passed to an auxiliary flash system. The evaporator operated at a temperature such that appreciable cracking occurred therein.

Different units, otherwise essentially identical, were equipped with evaporators ranging in size from vessels 5 ft. in diameter and 37 ft. high to vessels 10 ft. in diameter, 30 ft. high. It was observed that the units equipped with larger evaporators tended to produce more volatile gasoline of higher octane number, and were of higher capacity, than the units equipped with small evaporators. This effect was attributed to the increased amount of cracking that occurred outside of the furnace coil in the units equipped with large evaporators.

A program of laboratory experimental cracking was performed to investigate these factors. The expected effects were strikingly confirmed; i.e., coil-and-chamber cracking produced more volatile gasoline of higher octane number, and the unit capacity was greater, than in the case of coil-only cracking.

A commercial unit next was equipped with a small auxiliary downflow reaction chamber, essentially as shown in Fig. 1. A test program was performed with the vessel in and out of service, and the anticipated effects of the chamber were confirmed again. Since then Standard Oil Co. of California has installed auxiliary reaction chambers on eight cracking units. All of them operate essentially as shown in Fig. 1. The different

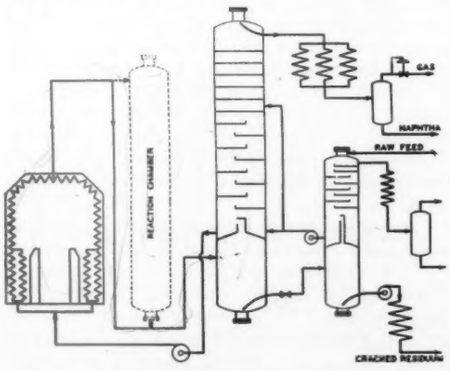

Fig. 1—Flow diagram of cracking unit

chambers have been in service from 1 to 5 years, and extensive commercial test data on them have been obtained.

This paper presents a brief summary of the effects on plant operation and product quality that resulted from installation of the auxiliary chambers.

A. P. I.

ABSTRACT

In recent years the Standard Oil Co. of California has installed auxiliary downflow reaction chambers on eight cracking units having a total raw-feed capacity of approximately 90,000 bbl. per day. The results have been highly satisfactory.

In this paper correlations are presented relating reaction-chamber size with results obtained by the use of these chambers. It is shown that their use increases the severity of cracking of the gas-oil component of the raw feed, and decreases the severity of cracking of the asphaltic component. This results in production of cracked residuum of lower sediment content and increased viscosity, and of cracked gasoline with increased volatility and higher octane number. Use of chambers also results in increased plant capacity, due to decrease in the heat requirement for cracking, to reduction in tube coking, and to improved furnace conditions.

These advantages result in appreciable decrease in the manufacturing cost of cracked gasoline. It is believed that installation of additional reaction chambers on many of the cracking units in use in this country would be advantageous.

Paper presented before Division of Refining at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

(Picture of Mr. Mithoff appears on Page 81.)

L. F. SCHIMANSKY

Theory of Reaction Chambers

Cracking stock processed by Standard Oil Co. of California is substantially heavier than are most of the stocks processed in the East. At different times residuums from California crudes have been cracked—these ranging in Saybolt Universal viscosity from 125 to 2,500 seconds at 130° F., and in A.P.I. gravity from 14° to 23°. The average for these residuums is a Saybolt Universal viscosity of about 800 seconds at 130° F., and they contain approximately 45 per cent of 70-penetration asphalt. This means that, with this California stock, more cracking occurs in the liquid phase than occurs with the lighter Mid-Continent or eastern stocks; and that also, with this California stock, furnace-tubing coking is more severe than with the lighter Mid-Continent and eastern stocks.

In a cracking unit operating without a reaction chamber, furnace conditions severe enough to obtain the desired conversion of the vaporized gas-oil component of the charging stock overcrack the heavy constituents that remain in the liquid phase in the tubes.

One method often employed to offset this disadvantage is two-coil operation, wherein a side cut from the vapor column is circulated through a light-oil cracking furnace. However, most California charging stocks do not produce sufficient oil of appropriate boiling range for recirculation to the light-oil furnace. This situation is aggravated further by the fact that lean naphtha (often containing less than 80 per cent of gasoline) must be produced in order to supply cutter stock for the heavy cracked residuum that is produced from most California charging stocks.

Advantages Gained

Use of a downflow reaction chamber on a single-coil unit effects many of the advantages of two-coil operation, without the foregoing disadvantage, when heavy oil is charged. The top transfer oil from the furnace is a mixture of liquid and vapor, and is discharged at essentially full cracking temperature into the top of the reaction chamber. The liquid constituents flow rapidly down the walls or fall through the vapor, under the influence of gravity, to the bottom of the vessel, and promptly are ejected therefrom in the combined liquid and vapor stream. However, the vaporized constituents of the oil from the furnace top transfer line drift slowly downward through the vessel, being forced forward only as additional vapor enters the top of the chamber. This situation results in exposure of the vapor in the chamber to cracking conditions for a period several times longer than exposure of the liquid. This means that, in the unit as a whole, the vapor is cracked appreciably more severely than is the asphalt—which is one of the main objectives of two-coil operation.

Use of a reaction chamber, therefore, allows the over-all degree of cracking in the unit to be increased without undue coking, because the chamber permits increase in the severity of cracking of the low-coke-forming gas oil, without increase in the severity of cracking of the high-coke-forming asphalt. This results in increased unit capacity, gasoline of improved quality, and cracked residuum of lower sediment content.

Use of a reaction chamber decreases the proportion of the total cracking that must be done within the furnace coil. This markedly decreases the amount of coke deposited in the tubes, especially as it is in the later stage or coke-forming part of the cracking reaction—during which, in many cases, coke formation is heaviest—that coke is formed in the reaction chamber. Coke formation in the chamber is less harmful to economical operation of the unit than is coke formation in the furnace tubes, because more coke can be deposited in the chamber before a shutdown for cleaning is required.

Installation of a reaction chamber changes the cracking reaction from a short-time high-temperature process (as in coil-only operation) to a long-time lower-temperature process. This increases

the amount of polymerization of olefinic compounds, especially those within the gasoline boiling range. The primary cracking reaction is endothermic, and polymerization is exothermic; hence, the chemical heat of reaction in the overall cracking process is reduced by installation of a chamber—and this results in increased plant capacity. The increase in polymerization also may account in part for the improvement in the octane number of the gasoline.

Use of reaction chambers decreases the net heat requirement for cracking more than can be accounted for by decrease in the chemical heat of reaction. This is due to increase in the volatility of the naphtha and cracked residuum—which lowers the temperature at which the cracked products leave the unit. In this connection it should be pointed out that ordinarily no naphtha is recirculated to the top of the vapor column in units like those shown in Fig. 1 when heavy California residuums are charged.

Although use of reaction chambers is believed to increase the amount of polymerization that occurs in the unit, nevertheless, the yield of butenes per barrel of cracked gasoline is essentially unchanged. The reason for this is not clear, although it may be that in this regard the increase in polymerization is offset by the increase in severity of cracking of the gas oil.

Method of Correlating Results

The effects of reaction chambers described hereinbefore are truly a result of change in the time-temperature relation for the gas-oil and asphalt components of the furnace feed. Complete correlation of the effects of the chamber, of course, would have to include calculation of the change in time-temperature relation for both of these components. This calculation, however, would be laborious; and its accuracy would be questionable A simpler correlation factor is desirable.

After trial of many different factors for this purpose, it was found that the quotient of the volume in which cracking occurs outside of the furnace divided by raw-feed rate correlated quite well with all of the observed effects of addition of chambers. Numerically, the quotient is the sum of the volume of the reaction chamber, in cubic feet, plus one-half of the volume of the evaporator, in cubic feet, divided by the raw-feed rate, in thousands of barrels per day. These units were adopted to give a factor of convenient numerical size. It is designated herein as V/R. In this expression, evaporator volume was assigned only one-half the effectiveness of reaction-chamber volume; because it was observed, in commercial operation, that the evaporator operated at lower temperature than did the reaction chamber, the difference being such that about one-half of the reaction rate would be expected.

The relation between severity of cracking of the gas oil and asphalt is also dependent upon the shape of the auxiliary reaction vessel employed. The time that the gas oil spends in the vessel is dependent upon the volume of the vessel; whereas the time that the asphalt spends therein depends upon the distance that it must fall within the vessel, i.e., upon the height of the vessel. The ratio of height to diameter of all of the reaction chambers employed by Standard Oil Co. of California is within the range of approximately 6:1 to 8:1. This range is too small for the shape factor to be perceptible in results obtained from the cracking unit. However, chambers of markedly different relative dimensions may give results appreciably different from those presented herein.

It is realized that use of the correlation factor V/R leaves much to be desired. However, the results obtained by its use were sufficiently accurate for solution of the engineering, process, and economic problems involved; and the laborious calculations based upon a sounder theoretical background could not be justified.

Heat Requirement

Fig. 2 is a graph showing the effect of reaction

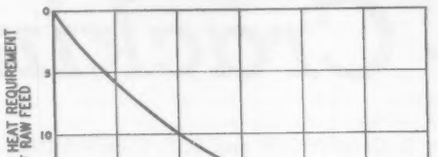

Fig. 2—Effect of reaction volume on total heat requirement of cracking per barrel of raw feed

chambers on the net heat requirements of cracking heavy California residuums in equipment similar to that shown in Fig. 1. This graph is based on raw feed entering the unit at 60° F., with no indirect heat exchange employed in the unit, and no naphtha recirculation to the top of the fractionating column. Fig. 2 is based on a large number of experimental and commercial data, and is believed to be quite accurate.

As an example of the reduction in heat requirement obtained in commercial practice, the Standard Oil Co. of California installed 8-ft. by 50-ft. reaction chambers on four units, each with a daily feed capacity of approximately 8,000 bbl. The units were designed essentially as shown in Fig. 1. Installation of the chambers increased the V/R from about 50 to about 300. Test data showed that the heat requirement was decreased about 17 per cent, which is in close agreement with the graph shown in Fig. 2.

The following tabulation indicates the heat requirement before and after installation of the chambers:

	B.t.u. per barrel of raw feed		Decrease (per cent)
	Without chamber	With chamber	
Heat differential:			
60° to raw-feed temperature of 140° F.	14,000	14,000	..
Absorbed in raw-feed-naphtha heat exchanger	20,000	17,000	
Absorbed in furnace	166,000	135,000	19
Total requirement above 60° F.	200,000	166,000	17

This particular installation saved about 31,000 B.t.u. in furnace-heat absorption per barrel of raw feed, which, at 70 per cent furnace efficiency, corresponds to a saving of about 7 bbl. of fuel per 1,000 bbl. of cracking stock processed.

Capacity of Unit

It has been the experience of the Standard Oil Co. of California that the maximum annual throughput and the minimum operating and maintenance cost per barrel of gasoline are obtained if the cracking plant is operated at a high feed rate, such that tube coking necessitates shutdowns for cleaning after runs of about 700 hours. The rate of tube coking in a given furnace is dependent upon the total heat absorption therein; hence, a reaction chamber increases the capacity of a given cracking unit due to the decrease in the required heat absorption per barrel charged.

In addition to the above factor, a reaction chamber transfers the more severely coke-forming part of the cracking reaction to a point outside of the furnace tubes. This permits a given furnace to absorb more heat per hour, for a given rate of coke deposition, if a unit with a reaction chamber is used than if no chamber is employed. This factor permits a greater increase in the raw-feed rate to be made when a chamber is installed than would be anticipated on the basis of the decrease in heat requirement alone.

Fig. 3 shows the percentage increase in daily feed capacity obtained in the different Standard Oil Co. of California plants when reaction chambers were installed. This chart corresponds to production of a given yield of cracked naphtha of a given gasoline content. The gasoline content of the naphtha assumed in preparing this chart was 80 per cent, which is a value readily obtainable on units either with or without reaction chambers.

In the example cited previously, viz, installations of an 8-ft. by 50-ft. chamber on an 8,000-bbl.-per-day unit, V/R was increased from 50 to 300, and the raw-feed capacity was increased 27 per cent (up to 10,200 bbl. per day) for operation at constant naphtha yield and gasoline content. This corresponds to an increase of 27 per cent in the daily gasoline-producing capacity of the unit. These results are in accord with the graph shown in Fig. 3.

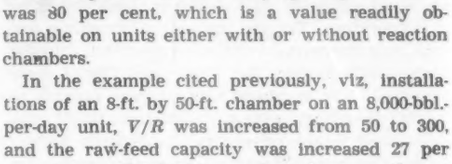

Fig. 3—Effect of reaction volume on raw-feed capacity of a cracking unit—operation at constant naphtha yield and constant gasoline content of naphtha

When heavy California residuum is charged, a unit similar to that shown in Fig. 1 makes its maximum daily gasoline production at approximately 80 per cent gasoline content in naphtha (400° F. end-point gasoline) with $V/R = 50$ (without reaction chamber) and at approximately 100 per cent gasoline content with $V/R = 300$ (with chamber). The attempt to produce more volatile naphthas than these—whether by an increase in the proportion of the mixed feed going to the upper part of the vapor column or by the recirculation of naphtha to the top of the column—always results in a market decrease in the gasoline-production rate. Use of a reaction chamber is, therefore, an economical means both of increasing the gasoline content of naphtha and raising the gasoline yield.

Fig. 4 shows the changes in plant capacity that occur when a reaction chamber is added, provided the unit is operated in all cases with the gasoline content of the naphtha such that the maximum daily production of gasoline will result. The increase in feed rate obtained under these conditions is less than what would be obtained if naphtha of a fixed lower gasoline content were made; however, this penalty is offset by a greater increase in the daily gasoline production from the unit.

In the example cited previously, i.e., in which an 8-ft. by 50-ft. vessel was added to an 8,000-bbl.-per-day unit, the feed rate would be increased 16 per cent, or to 9,300 bbl. per day; the gasoline content of the naphtha would be increased from

80 to 100 per cent; and the daily production of gasoline would increase 45 per cent, as compared with an increase of only 27 per cent if the naphtha quality were maintained constant.

The refinery demand for light gas-oil cutter stock determines which of the above alternatives will be used in any given case to realize the advantages resulting from installation of reaction chambers. In many cases the most advantageous results may be obtained at some intermediate point.

Quality of Cracked Products

Use of reaction chambers decreases the severity of cracking of the heavy asphalt constituents of the charging stock. This means that the asphalt is less severely viscosity broken, and the viscosity of the cracked residuum for a given naphtha yield is increased. A charging stock with a Saybolt Universal viscosity of 800 seconds at 130° F., is cracked to yield 35 per cent naphtha in a unit of 50 *V/R*, produces a cracked residuum with a Furol viscosity of approximately 400 seconds at 122° F.; whereas in a unit of 300 *V/R* the Furol viscosity of the residuum is about 580 seconds at 122° F. for the same naphtha yield.

California refiners often encounter some difficulty in meeting the viscosity specification of the different cracked fuels sold, due to the high percentage of heavy ends in most California crude oils. The decrease in degree of viscosity-breaking is, therefore, an undesirable factor in the use of reaction chambers; however, this usually can be offset by other feasible changes in the refinery stock balance. This problem would not exist in refineries processing lighter crude oils.

Use of reaction chambers also appreciably decreases the sediment content of the cracked residuum produced at a given yield of cracked naphtha. This effect is probably due to the decrease in severity of cracking of the asphalt component of the charging stock.

Cracking units equipped with reaction chambers produce gasoline of higher volatility than do units without chambers. The spread between the 50 and 90 per cent points is increased, the spread between the 20 and 50 per cent points remaining essentially unchanged. The magnitude of this effect is shown in Fig. 5. For example, installing an 8-ft. by 50-ft. chamber on an 8,000-bbl.-per-day unit lowered the 20 and 50 per cent points of gasoline of a given 90 per cent point by about 6° F.

Chambers also increase the octane number of the cracked gasoline, due in part to the increase in volatility and, in part, to change in chemical character of the gasoline. As shown in Fig. 5, installation of an 8-ft. by 50-ft. chamber on an 8,000-bbl.-per-day unit raised the C.R.F. motor-method octane number of gasoline of a given 90 per cent point by 0.8.

In none of the tests performed by the Standard Oil Co. of California was it found that the use of reaction chambers caused any detectable change in the sulfur content, amount of acid required for finishing, or in the lead susceptibility of the cracked gasoline.

Improvement in Plant Operation

A reaction vessel serves as a surge chamber to absorb fluctuations in the operation of the cracking unit. A unit equipped with a reaction chamber is substantially easier to operate and control than a unit not so equipped. Abrupt variations in feed quality or in top transfer temperature are less likely to coke the tubes, because the coke-forming part of the reaction occurs primarily in the chamber. Uncontrollable "swings" in the operation are also substantially less likely to occur.

It is, therefore, possible to operate a unit with a chamber substantially closer to its maximum theoretical capacity than a unit without a chamber. Shutdowns for cleaning because of coke which formed during accidental "swings" are less frequent. Standard Oil Co. records show that the installation of chambers improved the equivalent operating factor of the unit about 5 per cent for the foregoing reasons. This improvement in operating factor resulted in a 5 per cent increase in the annual plant throughput over and above the increase in maximum theoretical capacity shown in Figs. 3 and 4.

Economics of Reaction Chambers

Use of reaction chambers effects an appreciable saving in the unit manufacturing cost of the gasoline. The unit labor cost is reduced, because the plant capacity is increased without increase in the number of men required to operate the plant. The fuel cost is decreased, because the net heat requirement of cracking is reduced, and because the furnace usually can be operated at higher efficiency. A small saving in cooling water is made, because the products leave the unit at lower temperature.

Standard Oil Co. of California experience has been that the annual maintenance cost for a given unit is essentially the same whether a chamber is employed or not. Hence, the maintenance cost per barrel of gasoline is decreased approximately in proportion to the increase in plant capacity.

The increase in octane number of the cracked gasoline can be utilized either by a decrease in the amount of tetraethyl lead, or by diversion to same other gasoline—in which their value may be greater—of other high-octane stocks used in the final gasoline blend. The increase in volatility of the cracked gasoline may be utilized by a decrease in the volume of natural gasoline employed in the refinery, or by other readjustments in the refinery stock balance.

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Use of chambers decreases the degree of viscosity breaking obtained in the unit, but it is difficult to evaluate financially the penalty that may result from such decrease in viscosity breaking. No penalty would exist in refineries that process light crudes. In refineries that process heavy crudes and that are short of light gas oils, detailed analysis of the entire refinery stock balance is required to find means of offsetting the decrease in viscosity breaking resulting from use of chambers.

In analyzing the economy of installing reaction chambers on new or existing cracking units, study must be made to ascertain if the advantages of these chambers are truly realizable in the particular refinery stock situation in question. For example, if the chambers were to be installed on existing units, and if no increase were required in the daily cracked-gasoline production in the refinery, it is possible that little saving in unit operating cost would be made, unless one or more of the units could be shut down as a result of the increased capacity of the others. Similarly, little credit could be taken for improved volatility of the cracked gasoline unless it were possible to decrease the refinery input of natural gasoline.

In all of the installations of reaction chambers made by the Standard Oil Co. of California, it was found possible to take full advantage of all of their favorable effects described hereinbefore. Other means were found to offset the disadvantage of reduced viscosity breaking.

Reaction Chambers vs. New Units

When a refinery stock situation reaches the point where increase in the cracked-gasoline production is required, decision on the following factors is necessary:

1. Should a new cracking unit of the existing type be built.
2. Should the new unit include a reaction chamber.
3. Should reaction chambers be installed on existing cracking units.
4. What is the economical size of the reaction chambers to be installed.

Usually these questions resolve themselves into finding the cheapest way of obtaining the required additional capacity. If the required increase in gasoline production is within the range of that attainable by the installation of reaction chambers on existing units, it is believed that this alternative is far cheaper than to build new units.

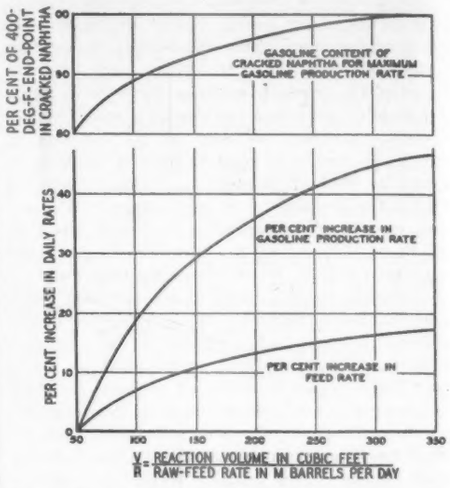

PER CENT OF 400-DEG-F-END-POINT IN CRACKED NAPHTHA
GASOLINE CONTENT OF CRACKED NAPHTHA FOR MAXIMUM GASOLINE PRODUCTION RATE
PER CENT INCREASE IN DAILY RATES
PER CENT INCREASE IN GASOLINE PRODUCTION RATE
PER CENT INCREASE IN FEED RATE
V = REACTION VOLUME IN CUBIC FEET
R = RAW-FEED RATE IN M BARRELS PER DAY

Fig. 4—Effect of reaction volume on feed rate, gasoline content of cracked naphtha, and cracked-gasoline producing capacity of a cracking unit—based on operation for maximum gasoline production

If, for example, an 8-ft. by 50 ft. vessel, costing perhaps $60,000, were installed on an existing 8,000-bbl.-per-day unit, the daily gasoline production therefrom would be raised from about 2,300 bbl. to about 2,900 bbl., or an increase of about 600 bbl. per day (27 per cent), for constant naphtha yield and quality. The additional gasoline, therefore, would be obtained from an investment of only about $100 per barrel per day, as compared to about $225 for construction of a new unit of the type shown in Fig. 1.

Construction of new units, of course, would be required if the necessary increase in gasoline production were larger than that attainable by the installation of reaction chambers on all existing units. Even in this case, however, consideration should be given to the attainment of at least part of the required increase in capacity by installation of chambers.

(Continued on Page 146)

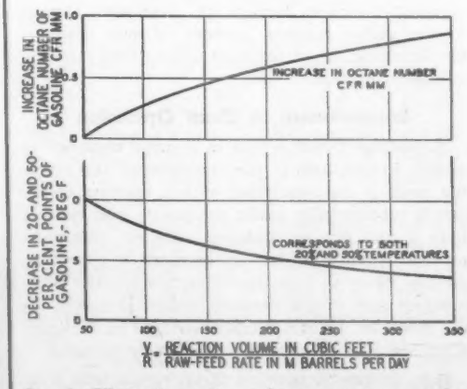
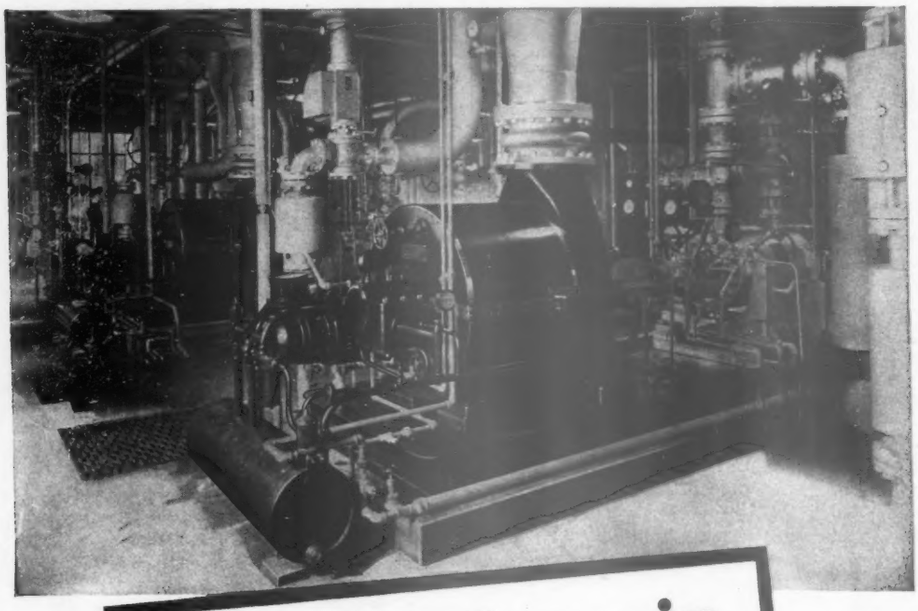

INCREASE IN OCTANE NUMBER OF GASOLINE CFR MM
INCREASE IN OCTANE NUMBER CFR MM
DECREASE IN 20- AND 50-PER CENT POINTS OF GASOLINE, °DEG F
CORRESPONDS TO BOTH 20 AND 50 % TEMPERATURES
V = REACTION VOLUME IN CUBIC FEET
R = RAW-FEED RATE IN M BARRELS PER DAY

Fig. 5—Effect of reaction volume on octane number and volatility of gasoline of constant end point and vapor pressure



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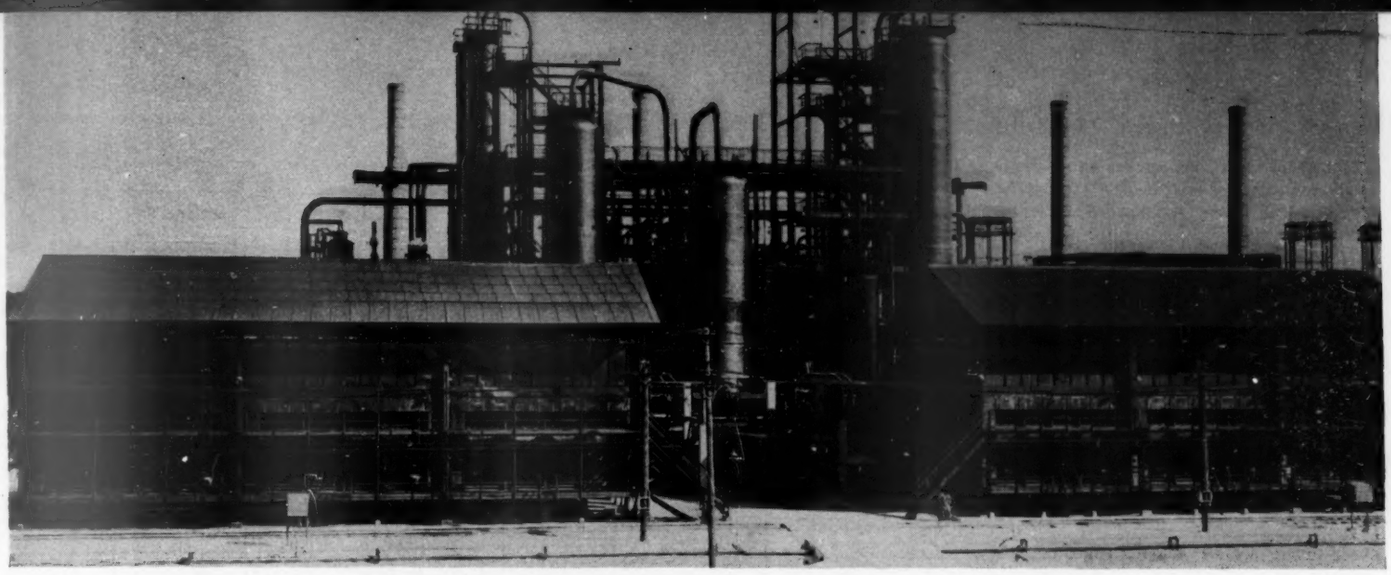


View of 22,000 bbl. per day combination crude polyform unit

Polyform and Gas Reversion Processes. . . and the Natural Gas Industry

By E. R. SMOLEY and V. O. BOWLES
Lummus Co.

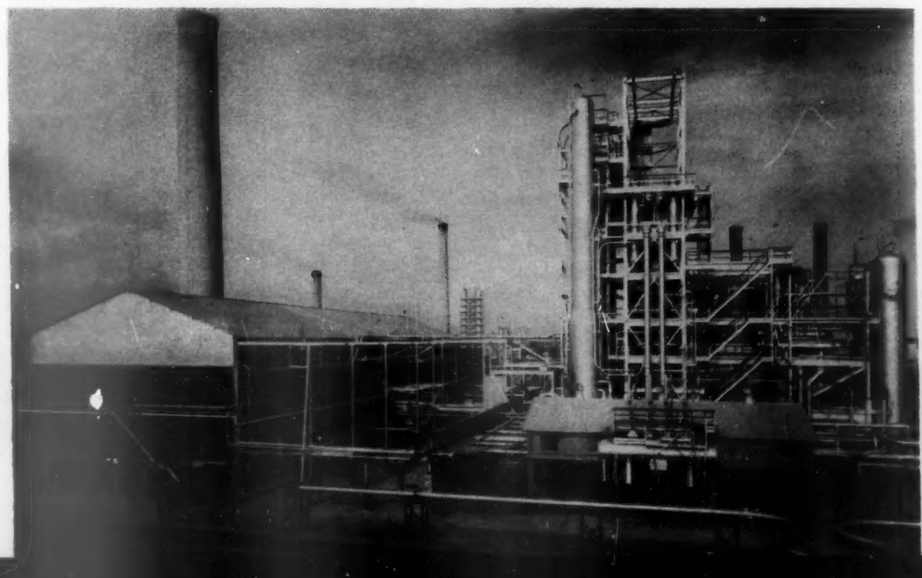
C.N.G.A.—Presented before meeting of the California Natural Gasoline Association, Los Angeles, Calif., October 31.

THE great recent demand by the U. S. Defense Council and the Army and Navy for large quantities of high-octane gasoline makes this paper especially timely. In this present war emergency, oil men must carefully consider every method of producing the highest grade of gasoline at the lowest possible cost. Perfection of product is, of course, paramount. But economy in production both as to money and material is vitally important too. The utilization of propanes and butanes from the natural-gasoline industry for the economic production of high-octane gasoline adheres to this program, as does the production of butylenes for the manufacture of valuable aviation alkylate. Large government orders and demands for high-octane gasoline have already caused many oil-refining companies to investigate and install the new polyform and gas reversion processes because these processes make both cheaper and better gasoline of higher octane number.

Throughout the country polyform and gas reversion plants now process close to 100,000 bbl. daily of naphthas, propanes and butanes, of which approximately one-third are propanes and butanes; a good share of these come from the natural-gasoline industry. A year ago there were 11 polyform installations. Today there are 14 such plants in operation and 4 more under construction. The operation of the last two units recently completed has greatly exceeded expectations in yield, octane and general results.

Because of defense requirements for vast quantities of high-octane aviation and motor fuels, and because of the commercial demands for even higher and higher octane number gasoline, every refiner is vitally interested in elevating the octane of his production by new refining methods.

View of 10,000 bbl. per day 88-Research octane naphtha polyform plant charging outside gases



To illustrate these rising trends of motor gasoline octane number, the data submitted by the Bureau of Mines Cooperative Fuel Research Motor Gasoline Survey over the past 5 years are presented here. Fig. 1 shows the trend of the average motor fuel octane numbers in the United States from 1936 to date. The premium grade has risen from

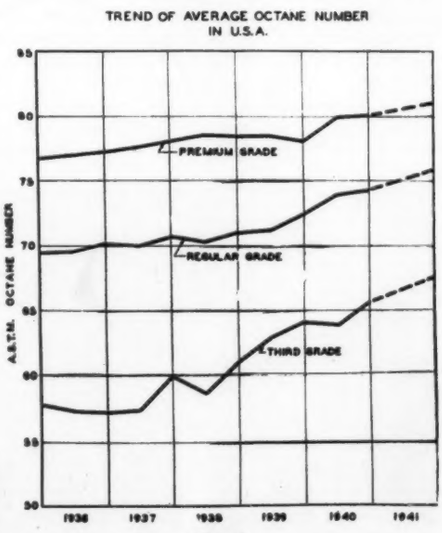


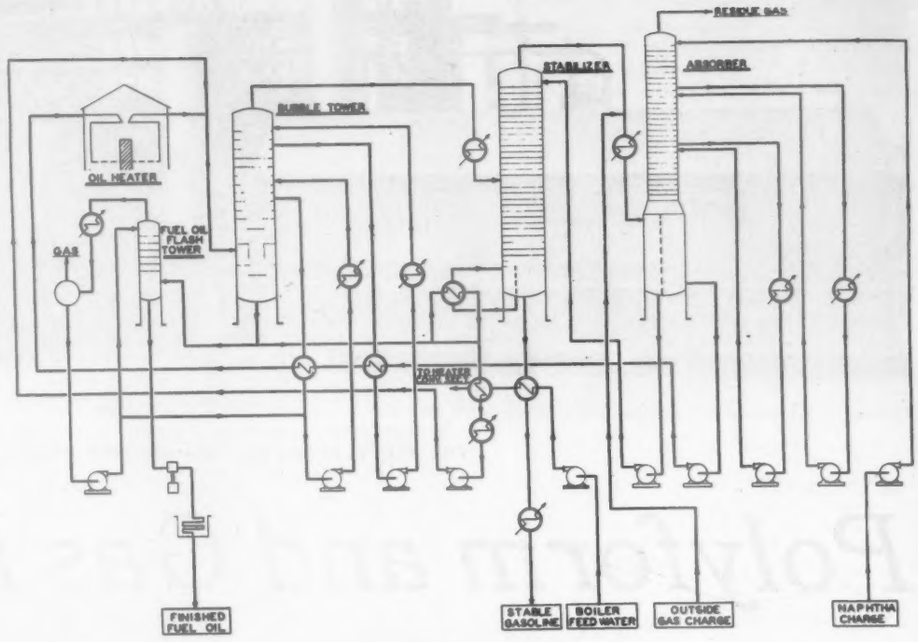
Fig. 1

76.8 in 1936 to 80.4 in the winter of 1940-41 indicating a rising trend of one octane number per year. The regular grade has risen from 69.5 A.S.T.M. octane to 74.5 during this same period, while the third grade rose from 57.2 to 65.5. Current defense requirements are making it more and more difficult for refiners to maintain the high octane of their commercial production. This has already been recognized by many refiners who are installing refining processes such as the polyform process which produce a large volume of higher octane number gasoline for blending with the refinery production.

Means for many phases of octane number improvement may be provided by the naphtha polyform and gas reversion processes. Straightrun heavy naphthas may be polyformed for the production of high yields of 76 to 80 A.S.T.M. octane number gasoline. Straightrun gas oil, recycle gas oil, or catalytically cracked gas oils may be polyformed to 74-76 A.S.T.M. octane number with improved yields over conventional processing, and reduced crude may be polyformed at higher conversions per pass for the production of 70-72 A.S.T.M. octane number gasoline. Heavy cracked gasoline may be polyformed satisfactorily to 76 A.S.T.M. octane to further improve refinery octane numbers. The use of outside propanes and butanes either from refinery gas or from natural gas in naphtha polyform and gas reversion units has resulted in high yields of high-octane number gasoline from this source of raw material. The gasoline produced from polyform units has excellent blending value and good lead susceptibility. The spread between the A.S.T.M. and the Research octane number varies from 9 to 14 points and the appreciation of road octane number is excellent. Standard road tests have indicated that naphtha polyform gasoline of the same octane number is equivalent to gasolines made from catalytic processes.

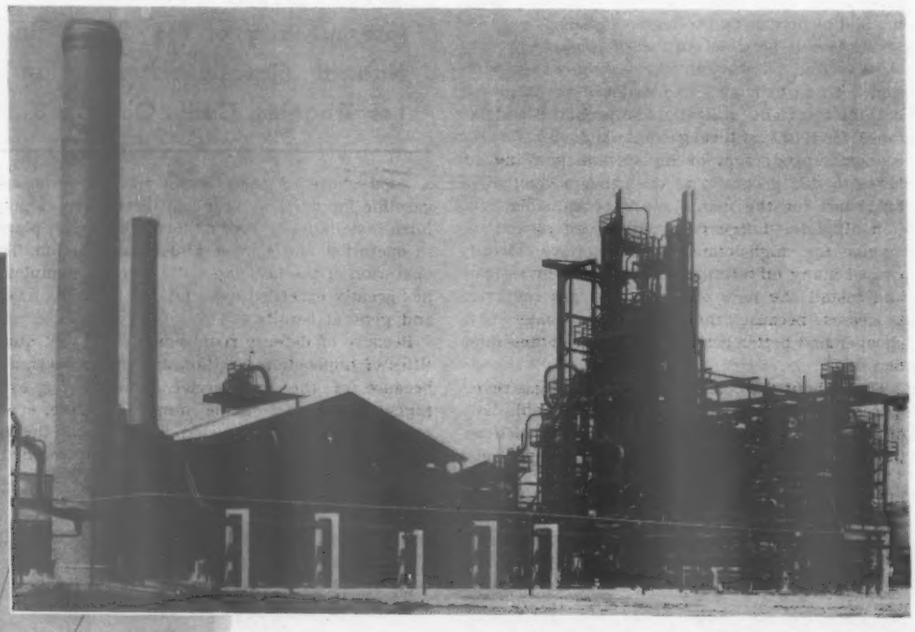
Aviation fuels which lead up to 91 A.S.T.M. octane number with less than 4 cc. of lead and meeting all Army specifications may be made from the polyform process. This stock may also be used as a base for blending with isopentane and aviation alkylate or isooctane and 3 cc. of lead to produce 100-octane aviation fuel meeting all of the Army specifications. The polyform distillates are rich in aromatics containing from 3 to 5 per cent toluene which may be economically recovered as nitration grade toluol by well known process methods. A very interesting application of the polyform process is the byproduct production of a butylene cut which may be used for the manufacture of aviation alkylate. The normal butanes from the alkylation plant are returned to the polyform unit to complete the cycle. The use of field butane in a polyform unit for the production of a BB cut for the manufacture of aviation alkylate will add to defense resources.

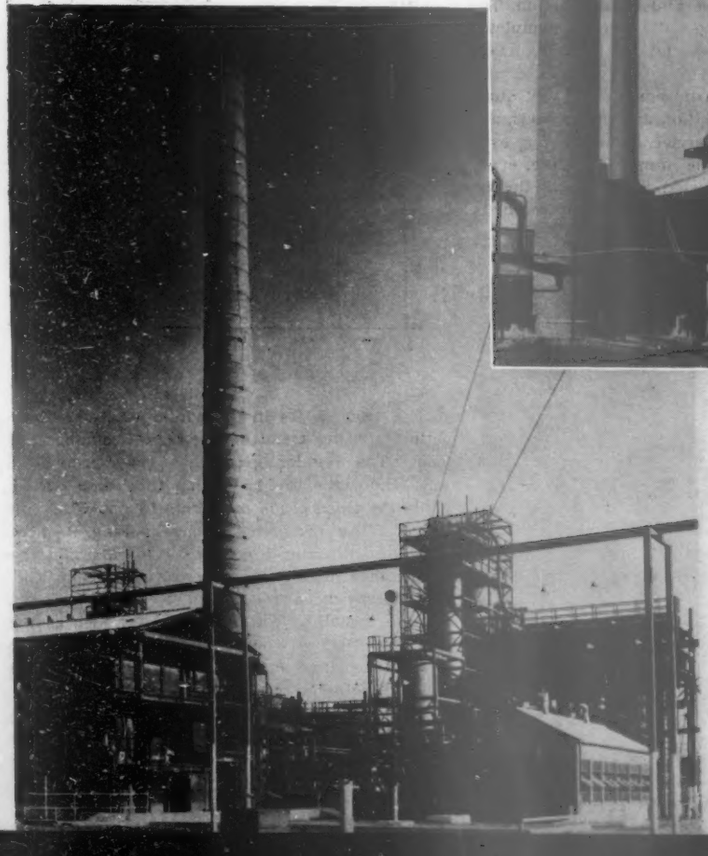
The naphtha polyform and gas reversion processes employ the principle of cracking an oil in admixture with various amounts of normally gaseous hydrocarbons (propanes and butanes). The oil in this mixture can be subjected to higher temperature and higher degree of conversion per pass than possible in the ordinary thermal-cracking process without the danger of coke formation in the cracking tubes, and without uneconomically large production of residue gases. Cracking velocities of individual propanes and butanes are increased when admixed with naphtha because of cooperation and partial consumption by alkylation and other synthesis reactions. Thus admixed gases have a pronounced physical effect on naphtha reforming which takes place concurrently with gas polymerization. Conversion conditions in naphtha reforming can be made more severe with attendant greater octane number improvement when the naphtha is admixed with gas conversion stock in sufficient amount.



NAPHTHA POLYFORM PLANT

Fig. 2





Above: View of naphtha polyform unit, Gulf Oil refinery, Cincinnati, Ohio

Left: View of naphtha gas reversion unit, Phillips Petroleum Co., Borger, Tex.

The naphtha polyform and gas reversion processes as applied to the conversion of low-octane heavy naphtha into high-octane gasoline are illustrated in the flow sheet, Fig. 2. The naphtha charge is pumped to the top of the absorber tower where it absorbs the propane and butane recycle from the unit. This rich naphtha serves

(Continued on Page 145)

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WELL LOGS and FIELD DATA . . . . of Active Oil Areas

Upper Gulf Coast District—Texas

(Compiled by The Oil and Gas Journal)

GENERAL GEOLOGY: The Gulf Coast is a part of the coastal plain of Texas, the upper district lying in front of the East Texas embayment between the Llano-Burnet and Sabine uplifts. Sediments of Cretaceous age outcrop around the margin of this embayment followed by a thick section of Tertiary beds. By the end of the Eocene the effect of the embayment largely disappeared and the strike of the beds is roughly parallel to the coast.

All formations dip gulfward and there is also considerable thickening of beds with the result that along the coast older Tertiary beds are beyond the reach of the drill now.

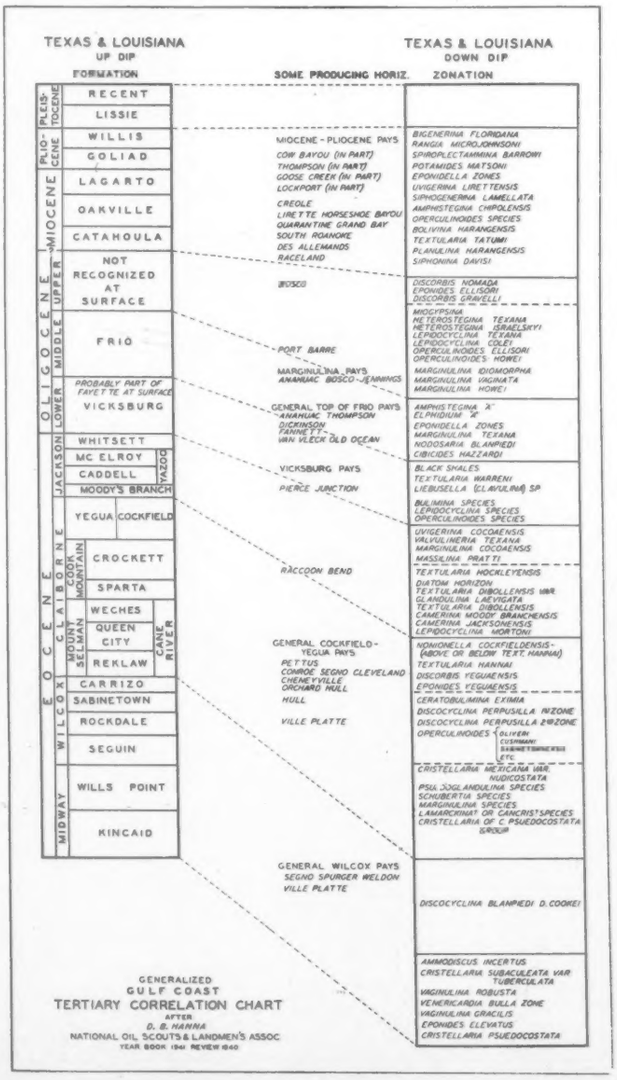
The later formations are alternating continental and marine beds with marine deposits predominating in the middle of the section in the northern part of the area and throughout the whole section near the coast.

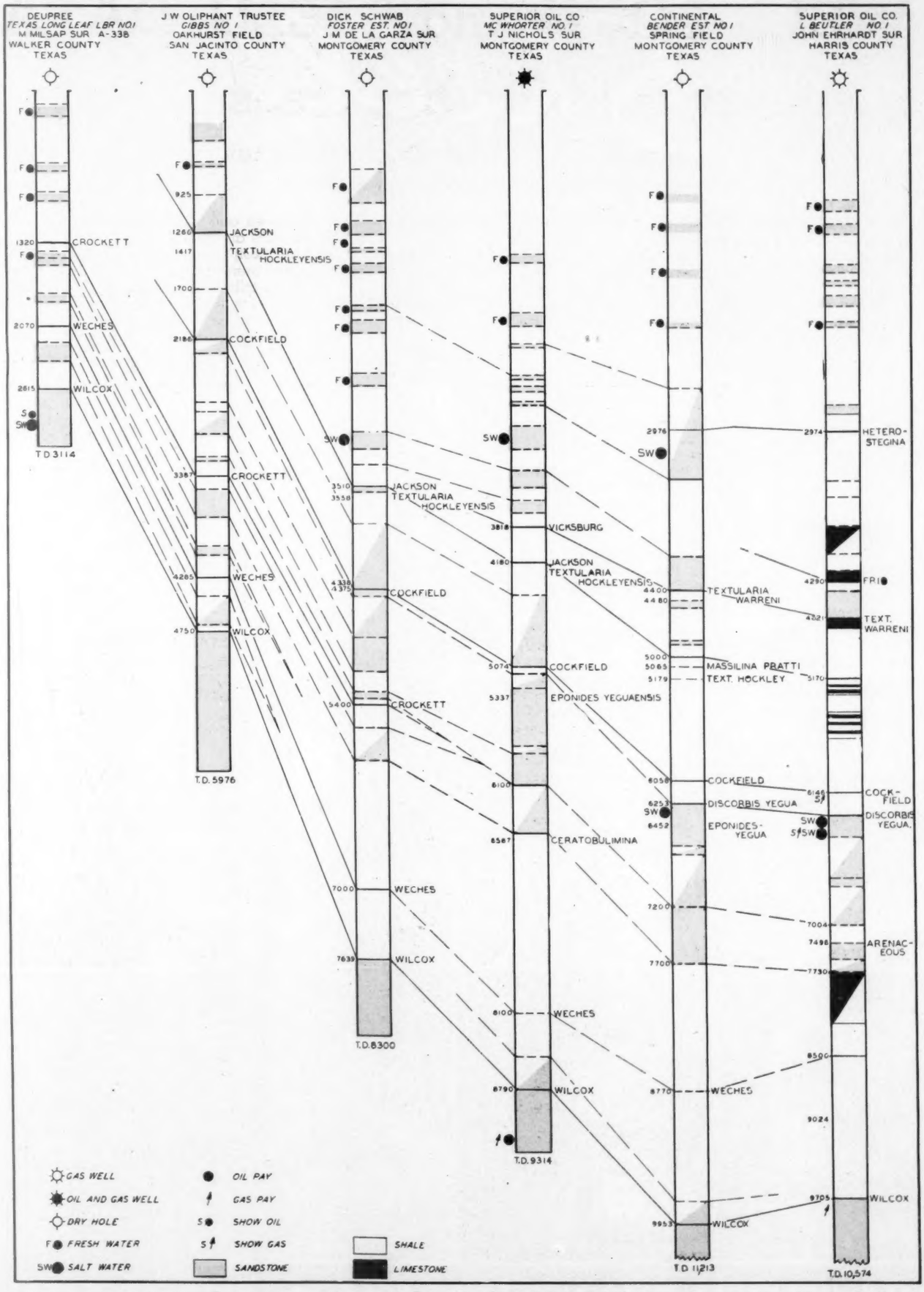
The predominant structural features are a complex series of faults formed by slumping of blocks of sediment during the subsidence of the area and a large number of salt domes which have risen to various heights in the section.

Recently, the emphasis has been placed more strongly on local gentle structures forming small uplifts in areas of lensing sands. This conception has had great practical effects in changing the practice of exploration for new pools.

DEVELOPMENT: Nearly 4,000,000 acres, or about one-quarter of the total area, are under lease and there are over 125 active fields in the district. Production began with the discovery of Spindletop in 1901 and for the next 25 years was largely confined to salt domes and other fields which could be located by surface geology. The second phase of oil development came with the perfecting of geophysical prospecting methods, particularly the refraction seismograph and the torsion balance. These instruments were responsible for the discovery of many more structures until they were displaced by the reflection seismograph which found many deep-seated domes and gentle structures on which many of the larger fields are located.

Just as there have been cycles in the type of structure sought, there have also been cycles in the formations which were the objectives of drilling. Gradually deeper horizons have been found productive, so that prospecting has tended to work north from the gulf as well as deeper in the more developed areas. With the discovery of oil in the Wilcox in Louisiana, there has been great interest in this formation and many tests have been sunk in the hope of finding Wilcox production. At first, it was considered that the best chances of finding oil were at the top of the Wilcox so that the great majority of tests stopped at this point. Now, however, it is realized that the whole Wilcox section may be oil-bearing and some recent tests report over 1,000 ft. of Wilcox sand with almost one-third of the section showing some saturation.




DEUPREE
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WALKER COUNTY
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1320 CROCKETT
2070 WECHES
2815 WILCOX
T.D 3114
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1266 JACKSON
1417 TEXTULARIA HOCKLEYENSIS
1700
2186 COCKFIELD
3387 CROCKETT
4285 WECHES
4750 WILCOX
T.D. 5976
DICK SCHWAB
FOSTER EST. NO1
J M DE LA GARZA SUR
MONTGOMERY COUNTY
TEXAS
3510
3558 JACKSON TEXTULARIA HOCKLEYENSIS
4338
4375 COCKFIELD
5400 CROCKETT
7000 WECHES
7639 WILCOX
T.D.8300
SUPERIOR OIL CO
MC WHORTER NO. 1
T J NICHOLS SUR
MONTGOMERY COUNTY
TEXAS
3818 VICKSBURG
4180 JACKSON TEXTULARIA HOCKLEYENSIS
5074 COCKFIELD
5337 EPONIDES YEGUAENSIS
6100
6567 CERATOBULIMINA
8100 WECHES
8790 WILCOX
T.D. 9314
CONTINENTAL
BENDER EST NO1
SPRING FIELD
MONTGOMERY COUNTY
TEXAS
2976
4400
4480 TEXTULARIA WARRENI
5000
5065 MASSILINA PRATTI
5179 TEXT. HOCKLEY
6058 COCKFIELD
6253 DISCORBIS YEGUA
6452 EPONIDES-YEGUA
7200
7700
8770 WECHES
9953 WILCOX
T.D 11,213
SUPERIOR OIL CO.
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JOHN EHRHARDT SUR
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TEXAS
2974 HETERO-STEGINA
4290 FRIO
4321 TEXT. WARRENI
5170
6148 COCK-FIELD
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7004
7498 ARENAC-EOUS
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8500
9024
9705 WILCOX
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GAS WELL
OIL AND GAS WELL
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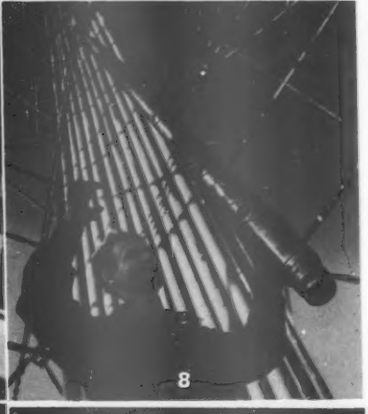
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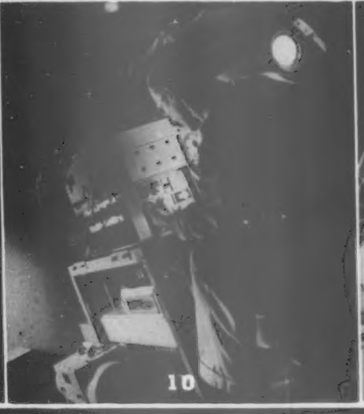
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11

1. Designing a Schlumberger instrument.
2. Inspecting a precision gun perforator part.
3. Machining a photoclinometer cage.
4. Assembling an electrical recording instrument.
5. Loading a side wall sample taker.
6. Running a side wall sample taker.
7. Testing precision gun perforator circuits.
8. Running a precision gun perforator.
9. Operating precision gun perforator controls.
10. Automatically recording an electrical well log.
11. Interpreting an electrical log at the well.

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as the furnace charge and after picking up preheat through exchangers passes through the furnace where outlet conditions of approximately 1,050° F. and 1,200 lb. pressure are maintained. The furnace outlet is quenched with circulating oil from the bottom of the evaporator tower and discharges into the evaporator and bubble tower which operates at about 400 lb. pressure and 625° F. flash temperature. The end-point gasoline is distilled overhead and stabilized. The stabilizer overhead consists of the propane and butane recycle, and the residue gas, which flow through the condenser into the absorber tower where the residue gas is separated from the remainder of the recycle. The processing of outside propanes and butanes may be carried out in this unit by adding these materials to the stabilizer overhead or as liquid feed to the furnace charge pump.

naphtha is passed over the absorber to separate the propane and butane recycle from the residue gas, and the rich naphtha from the base of the absorber is polyformed in the naphtha polyform coil. All four coils discharge into a common separator tower. The 10° to 12° A.P.I. gravity bottoms from this tower is reduced in the atmospheric tar stripper to the desired fuel-oil gravity, the overhead from the tar stripper returns to the bubble tower, and the side stream goes to the reduced crude vis-breaker.

Conversion of propanes and butanes concurrently with naphtha in polyform and gas reversion plants is especially interesting to most refiners just now, because the Government's vast defense requirements are severely taxing every facility for producing high-octane gasoline and are depleting commercial production of high-octane components.

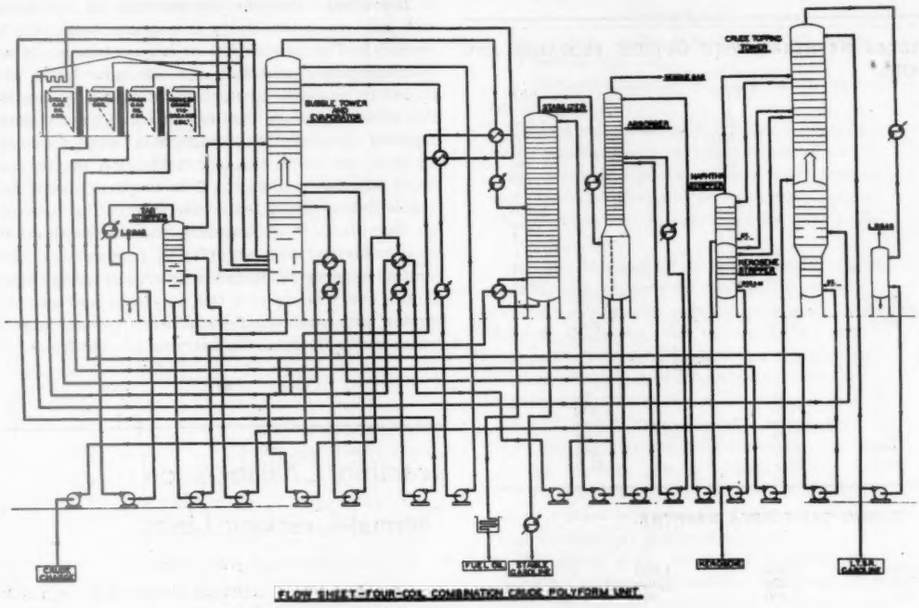

Fig. 3

The application of the polyform and gas reversion process to the cracking of a full crude is illustrated in the four-coil combination crude polyform unit flow sheet, Fig. 3. This flow sheet illustrates a 22,000-bbl. daily crude topping and polyform unit. This one unit replaces the conventional type of crude topping and cracking unit, a thermal polymerization unit and a gas compression and absorption plant.

The flow is simple. Crude is charged through heat exchangers and a heater convection bank into an atmospheric crude topping tower from the top of which straightrun gasoline is removed. Heavy naphtha and furnace oil or kerosene side streams are withdrawn through stripping towers, and below the furnace-oil drawoff a virgin gas-oil cut is removed. This virgin gas-oil cut is charged hot with propanes and butanes to the virgin gas-oil polyform coil where 34-45 per cent gasoline production per pass is obtained. Heavy reduced crude is charged hot from the bottom of the atmospheric tower through the polyform vis-breaker coil together with the heavy tar stripper side stream and propanes and butanes at a conversion per pass of approximately 14 to 16 per cent. The light recycle stock from the base of the fractionating tower is cracked in the recycle polyform coil with the propanes and butanes to approximately 25 to 32 per cent gasoline per pass. The C_3 and C_4 diluent for these three coils is all furnished as condensate from the stabilizer overhead and is composed of approximately 25 per cent butanes and 75 per cent propanes. Heavy

Resulting increase in tetraethyl lead requirements, therefore, sets a high value on any new high-octane production such as may be obtained from propanes and butanes. Table 1 illustrates the profitability of converting propanes and butanes in an average size polyform unit. The values of the propane and butane charges have been varied according to the sources of these materials. Field butane was considered to be available at 2 cents per gallon. Field propane was considered available at a cost of 1 cent per gallon. With gasoline bringing 6 and 6½ cents per gallon at the refinery, an average value of 7 cents per gallon for this high-octane gasoline production appears reasonable, the difference representing tetraethyl lead savings. Thus, with present-day plant costs, a payout on the increment investment of 1.7 years for field butane charge, and 3.4 years for field propane charge is indicated. If these propanes and butanes are obtained at fuel-gas value, payouts of 1.0 and 3.2 years, respectively, will be realized; while, if the propanes and butanes are obtained from the plant flare (having no value) then payouts of 0.7 and 1.7 years, respectively, may be obtained. The processing of propanes and butanes in a polyform or gas reversion plant adds only to the operating expense some utilities and maintenance.

The use of natural gasoline in the direct manufacture of 100-octane aviation gasoline simultaneously with high-octane motor gasoline is an application for the polyform and gas reversion processes which will interest all natural-gasoline producers. The hypothetical operation shown in the following example indicates a high potential production of 100-octane aviation gasoline from field casinghead. For example, consider a producer who has available 5,000 bbl. daily of 26-lb. casinghead containing approximately 3,000 bbl. daily of isopentane-free natural gasoline, 350 bbl. daily of isopentane, 1,100 bbl. daily of normal butane and 550 bbl. daily of isobutane. This stock would be deisopentanized and debutanized and the gasoline separated by distillation into aviation base stock and a heavy naphtha. The heavy naphtha (1,500 bbl. daily) would be polyformed with 1,100 bbl. daily of normal butane for the production of 1,300 bbl. daily of 76-octane motor gasoline and at the same time a byproduct butane-butylene stream would be withdrawn and charged to an alkylation plant along with the 550 bbl. daily of isobutane with a production of approximately 1,000 bbl. daily of 93-95-octane aviation alkylate. The normal butane from the alkylation operation would all be recycled to the polyform plant. The alkylate would be blended with the 350 bbl. daily of isopentane and 500 bbl. daily of the aviation base stock produced from the original natural gasoline, resulting in a net production of 1,850 bbl. daily of leaded 100-octane gasoline. Thus a charge of 5,000 bbl. daily of 26-lb. casinghead of the characteristics noted could produce 1,850 bbl. daily of 100-octane aviation gasoline plus 2,300 bbl. daily of 73 A.S.T.M. octane motor gasoline. This example indicates a high volumetric yield of 100-octane aviation and high-octane motor gasoline from the original natural gasoline charge.

Operating data from commercial polyform and gas reversion units have been published in the oil

TABLE 1—BUTANE AND PROPANE CONVERSION IN A NAPHTHA POLYFORM OR GAS REVERSION UNIT

	Case I-A	Case I-B	Case I-C	Case II-A	Case II-B	Case II-C
Charge	Butane	Butane	Butane	Propane	Propane	Propane
Source	Natural gas	Fuel gas	Plant flare	Natural gas	Fuel gas	Plant flare
Quantity, bbl./optg. day	1,000	1,000	1,000	1,000	1,000	1,000
Yields:						
Gasoline, bbl./optg. day	460	460	460	350	350	350
Fuel oil, bbl./optg. day	35	35	35	25	25	25
Fuel gas, bbl./optg. day (F.O.E.)	280	280	280	305	305	305
Charge value, dollars/day*	840	440	. . .	420	395	. . .
Operating costs, dollars/day†	135	135	40	275	275	75
Management, interest, taxes, dollars/day	75	75	75	140	140	140
Total charges, dollars/day	1,050	650	115	835	810	215
Gasoline value at 7.0 cents/gal., dollars/day	1,350	1,350	1,350	1,060	1,060	1,060
Fuel-oil value at 70 cents/bbl., dollars/day	24	24	24	17	17	17
Fuel-gas value at 10 cents/MM B.t.u., dollars/day	175	175	. . . .	191	191	. . . .
Total receipts	1,549	1,549	1,374	1,268	1,268	1,077
Net return, dollars/day	499	899	1,259	433	458	862
Net return, dollars/year	165,000	297,000	415,000	143,000	151,000	285,000
Increment plant cost, dollars	285,000	285,000	285,000	485,000	485,000	485,000
Payout time, years	1.7	1.0	0.7	3.4	3.2	1.7

*Natural butane at 2.0 cents/gal., natural propane at 1.0 cents/gal., fuel gas at 10 cents/MM B.t.u.
†Utilities: Fuel at 10 cents/MM B.t.u., water at 0.5 cent/1,000 gal., power at 0.5 cent/kw.-hr., no plant steam required.

journals September 1940 and the American Petroleum Institute Proceedings November 1940. Yields, octanes, lead susceptibility, inspections of charge and products, operating conditions, and blending results are given for various types of charge stocks and operations. A large polyform unit charging straightrun naphtha of 250°-400° F. boiling range and about 45-octane number from a mixture of Texas and coastal crudes along with outside propanes and butanes has recently been completed and placed on initial operation. During two 4-day test runs with frequent gagings, accurate yields of 83.5 per cent of 10 R.v.p. 400 end-point gasoline with a Research octane number of 87.5, and 95.5 per cent of 10 R.v.p. 400 end-point gasoline of 81 Research octane number were established. Table 2 presents some of the operating data. This yield-octane relationship as shown in Fig. 4 for both the Research and A.S.T.M. octane numbers is well substantiated by more than 750,000 bbl. of gasoline production in this plant at varying octanes.

A series of runs were made in the pilot plant, processing 52.9 A.P.I. gravity California naphtha with a boiling range of 160°-400° F. end point, having 58.3 A.S.T.M. octane number. The runs were made at a coil outlet pressure of 1,500 lb. and temperatures ranging from 1,060° to 1,100° F. The operating conditions, yields, octanes, inspections of charge and products are given for the four runs in Table 3. Fig. 5 shows the yield-octane relationship, indicating an 80 per cent yield of 79 A.S.T.M. octane number gasoline and a 90 per cent yield of 76 A.S.T.M. octane number gasoline. As would be expected from this California naphtha stock, a considerably higher yield-octane relationship was obtained than from Mid-Continent or Texas naphthas. These results indicate at least a 5 per cent higher yield at this octane range than from Texas stocks.

Because of the naturally high-octane number characteristic of most California straightrun gasolines, and because of the generally higher octane of cracked gasoline produced from the heavier oils, reforming California straightrun naphthas has not been practiced widely until very recently. However, the effect of defense requirements on the quality of commercial gasoline production, as well as the ever-rising octane level of all grades of gasoline will make it exceedingly difficult for most refiners to maintain the present high-octane level of their commercial production, even with all existing cracking facilities being employed to the fullest extent. For this reason the processing of low-octane gasoline components in polyform and gas reversion units is rapidly becoming a necessity. The production of high-octane gasoline from propanes and butanes not now being diverted to gasoline production is especially profitable where it can be carried out concurrently with naphtha polyforming., and is a step forward towards the more efficient utilization of the nation's natural resources. This is particularly desirable during the defense emergency. The byproduct manufacture of butylene for the production of valuable aviation alkylate is, furthermore, becoming imperative. Refiners are recognizing these factors everywhere and the polyform and gas reversion processes should find even greater application in the refining industry in the future.

TABLE 2—COMMERCIAL POLYFORM OPERATION OF TEXAS NAPHTHAS WITH OUTSIDE PROPANES AND BUTANES

Research octane No.		87.5		81.0	
Operating data:					
Coil outlet, temp. °F.		1,062		1,040	
Coil outlet pressure, lb./sq. in.		1,200		1,200	
Evaporator bottom temp., °F.		625		625	
Evaporator press., lb./sq. in.		390		390	
Absorber pressure, lb./sq. in.		340		340	
Yields, volume per cent:					
Charge naphtha		100.0		100.0	
Butanes		20.7		20.3	
Propanes		16.6		15.4	
Stabilized gasoline		98.0		110.0	
Fuel oil		4.8		2.4	
Calculated vol. per cent stab. gasoline on naphtha alone		83.5		95.5	
Laboratory inspections:	Charge naphtha	Stab. gasoline	Tar	Stab. gasoline	Tar
A.P.I. gravity	51.2	57.2	9.5	59.2	12.0
R.v.p., lb./sq. in.	...	9.7	...	10.0	...
Visc., S.U.S. at 122° F.	...	...	19	...	15
B.s. and w., per cent	...	...	0.4	...	0.4
A.S.T.M. distn., °F.:					
I.B.P.	205	95	...	94	...
10 per cent	260	130	...	134	...
50 per cent	310	232	...	243	...
90 per cent	360	339	...	327	...
End point	400	389	...	385	...
Research octane No.	44.0	87.5	...	81.0	...

TABLE 3—PILOT-PLANT DATA POLYFORMING CALIFORNIA NAPHTHA

Run No.	1			2		3		4	
Operating data:									
Coil outlet temp., °F.	1,070			1,080		1,090		1,100	
Coil outlet press., lb./sq. in.	1,500			1,500		1,500		1,500	
Tower press., lb./sq. in.	300			300		300		300	
Yields, vol. per cent:									
Stabilized dist.	92.4			90.3		83.9		79.7	
Tar	1.3			1.6		3.8		4.8	
Gas F.O.E.	6.2			7.3		12.2		15.2	
Laboratory inspections:	Charge naphtha	Stab. gasoline	Tar	Stab. gasoline	Tar	Stab. gasoline	Tar	Stab. gasoline	Tar
A.P.I. gravity	52.9	55.1	16.3	54.2	10.0	53.5	8.2	53.6	8.3
R.v.p., lb./sq. in.	...	8.8	...	8.5	...	9.5	...	9.1	...
A.S.T.M. distn., °F.:									
I.B.P.	160	93	394	95	426	94	421	92	428
10 per cent	211	153	485	155	500	144	491	139	480
50 per cent	267	247	526	245	599	238	591	234	571
90 per cent	344	348	...	360	...	349	...	359	...
End point	397	404	...	420	...	413	...	408	...
A.S.T.M. octane No.	58.3	73.8	...	75.5	...	78.2	...	79.3	...
Research octane No.	...	83.7	...	86.3	...	89.4	...	...	...

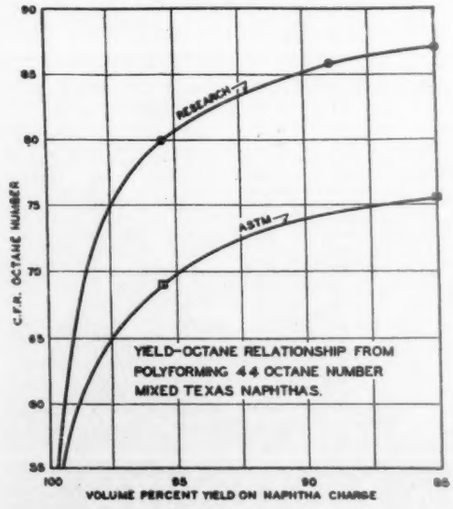
C.F.R. OCTANE NUMBER
RESEARCH-7
ASTM-7
YIELD-OCTANE RELATIONSHIP FROM POLYFORMING 44 OCTANE NUMBER MIXED TEXAS NAPHTHAS.
VOLUME PERCENT YIELD ON NAPHTHA CHARGE

Fig. 4

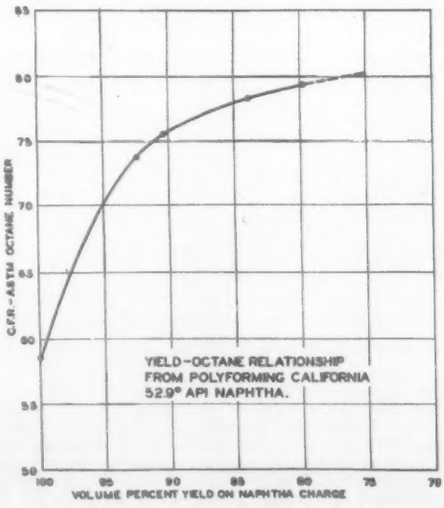
C.F.R.-ASTM OCTANE NUMBER
YIELD-OCTANE RELATIONSHIP FROM POLYFORMING CALIFORNIA 52.9° API NAPHTHA.
VOLUME PERCENT YIELD ON NAPHTHA CHARGE

Fig. 5

Reaction Chambers on Thermal-Cracking Units

(Continued from Page 140)

Analysis of each particular situation is required to determine the most economical size of reaction chamber to install on either the new or the existing units. If economic analysis shows that chambers would be desirable, it is believed that in most cases the vessels should be relatively large; i.e., of such size that a V/R of at least 300 to 400 is obtained. In the case of small cracking units it may be desirable to use a vessel giving a V/R substantially larger than this, as the incremental cost of obtaining the higher value of V/R may be relatively small.

As shown in Figs. 2, 3, 4, and 5, increase in size of reaction chambers is subject to diminishing return; however, up to the point of employing the largest vessels readily obtainable, the incremental cost of the large vessels as compared to the small ones is relatively small.

Many cracking units in this country are equipped with reaction chambers that correspond to a V/R of 100 to 200. It is believed that in many cases it would be worthwhile to give consideration to the replacement of the existing chamber by another larger vessel, or to the installation of another vessel in parallel.

Conclusion

During recent years the Standard Oil Co. of California has installed auxiliary downflow reaction chambers on most of its cracking units in service. Use of the chambers has resulted in increased plant capacity, improved product quality, and reduced cost. It is believed therefore, that installation of additional reaction chambers on many of the cracking units in use in this country would be advantageous.

Leak Resistance of Casing Joints in Tension

By P. D. THOMAS and A. W. BARTOK*
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A. P. I.

ABSTRACT

This paper consists essentially of two parts:

A. Tension-leak tests.

B. Photoelastic study of stresses in casing joints.

Leakage tests were made on casing joints subjected simultaneously to internal pressure and increasing tensile load. The loading under pressure was continued until full leakage was obtained. Pressure then was removed and the joint pulled to destruction.

Results indicated that the standard 8-pitch round-thread casing joint had leak resistance in tension beyond that required in service. Yield strength of the joint was apparently the controlling factor. Long-thread joints had a higher leak resistance than short-thread joints, although it was questionable if this extra tightness was of practical value. Thread lengths intermediate to A.P.I. long and short-threads appeared advisable. Thread makeup was a critical factor, three threads pullup being the optimum. Differential in taper lowered leak resistance, but this tendency was overcome by proper makeup.

Photoelastic study developed fundamental information concerning stresses in casing joints, supplementing and explaining the results of tension-leak tests. The usefulness of the photoelastic method in analyzing stresses in casing joints was pointed out.

Paper presented before the Division of Production at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

DATA presented in this paper establish clearly that standard A.P.I. round thread has leak resistance in tension beyond that required in service. To establish this point, leakage tests were made on eight-pitch round-thread casing joints subjected simultaneously to internal gas pressure and to tension loading. Tests were carried out on 4½-in., 5½-in., 7-in. or 8⅝-in. Grade J-55 casing.

To answer questions relative to stresses acting in the casing joint and their possible effect on leakage, and to supplement information developed in the tension-leak tests, a photoelastic analysis of the problem was made also.

Up to the time of these tests there was little definite information on leak resistance in tension. This investigation provides:

A. Experimental data that show how casing will perform under tension and pressure in service.

B. A testing procedure by which the leakage problem can be approached from the corrective angle, for example:

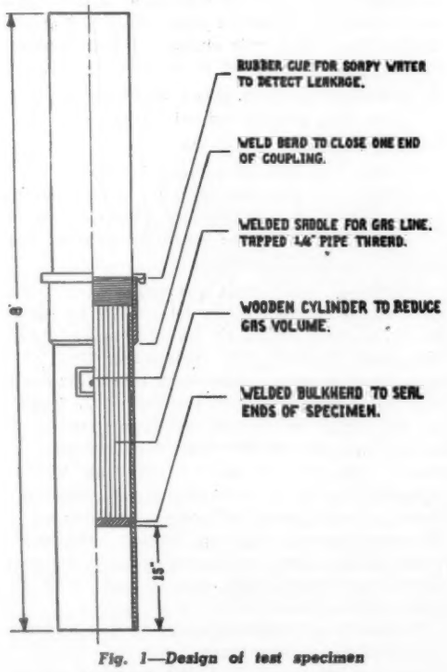
RUBBER CUP FOR SOAPY WATER TO DETECT LEAKAGE.
WELD BEAD TO CLOSE ONE END OF COUPLING.
WELDED SADDLE FOR GAS LINE. TAPPED ¼" PIPE THREAD.
WOODEN CYLINDER TO REDUCE GAS VOLUME.
WELDED BULKHEAD TO SEAL ENDS OF SPECIMEN.
8"
1½"

Fig. 1—Design of test specimen

1. With higher pressures.
2. With more sensitive leak-measuring methods
3. With various thread lubricants.

The tension-leak test program, as presented herein has the following objectives:

A. Determination of leak resistance of casing joints in tension.

B. Effects of the following factors on leak resistance in tension:

1. Thread length.
2. Makeup.
3. Taper differential.

C. Effects of stresses acting in casing joints.

*Paper extensively abstracted. Twenty tables and twenty-six charts omitted.

The scope of the paper is limited to casing joints using standardized A.P.I. 8-pitch, round thread.

Test Preparation

Preparation of specimens for testing involved the following steps:

A. Selection of samples.

B. Threading.

C. Making up joints.

D. Welding on saddles and tapping for gas connections.

E. Plugging with soft-wood rounds.

F. Welding in bulkheads.

G. Welding one end of coupling.

Fig. 1 shows the design of the assembly.

Samples used were representative of commercial production. Pipe was taken from stock, and the field-end threads used for units in the test. The balance of the pipe was cut as required into 4-ft. nipples for tension-leak tests and 2-ft. nipples for tensile tests. The long nipples were threaded to A.P.I. standards on the several machines producing casing at the time. Couplings likewise were taken from stock, selected only on the basis of handtight standoff. The integral-joint casing represented stock pipe except for one joint known to have a high pitch diameter in the box-end thread. Full data on pipe and thread dimensions were recorded, and from these were calculated the areas under the open roots of the last-engaged threads. Stress calculations were based on these areas. Another point of interest in the preparation of the joints was that they were made up from 3 weeks to 4 months ahead of testing, thus simulating a stocking period.

Particular attention was given to making up the joints, because previous tests had indicated that makeup practices were an important factor in joint leakage from the standpoint of both:

A. Number of threads pulled up by power from the handtight position of the coupling.

B. Damage and distortion resulting from undesirable makeup practices.

Couplings in this program were pulled to cover the last scratch, from 0 to ¾ turns past. Torque load was not recorded, but was reasonably uniform for the variations involved. Regular zinc-grease lubricant was used.

Gas inlet to the specimen was provided by welding a ⅜-in. saddle to the pipe and tapping for a ¼-in. standard air connection. The gas chamber was constructed by seating heavy bulkheads approximately 15 in. into the pipe and welding into place. Before welding in the second bulkhead, a soft-wood round—cut to provide ample clearance between the pipe walls and the round, and further reduced in diameter under the threads to avoid interference with thread collapse—was placed in the pipe to minimize the volume of gas under pressure. Leakage test was confined to one end of the coupling, the other being closed at the recess by welding.

Testing Equipment

The testing equipment used consisted of:

I. Tension-leak test:

A. Tensile machines:
1. 300,000-lb. tensile machine for the 4½-in.
2. 1,000,000-lb. vertical hydraulic tensile machine for the 5½-in., 7-in., and 8⅝-in.

B. Gas control board:
1. 400-lb.-per-sq.-in. pressure regulator and inlet-to-board and inlet-to-pipe valves.
2. Bypass valves for 1,000-lb.-per-sq.-in. pressure.
3. 1,250-lb.-per-sq.-in. safety valve.
4. Exhaust valve.
5. Line to test specimen.

C. Gas supply:
1. Nitrogen gas in bottles at 2,000 lb. per sq. in.
2. Six-bottle manifold and line to control board.

D. Leak reservoir:
1. Flanged rubber gasket fitted around coupling and providing trough permitting water to stand in recess and 1 in. above recess.
2. Soapy water.

E. Extensometers:
1. Rings fitted onto coupling and pipe with clamping arms for gages.

2. Two 1/10,000-in. calibrated dial gages, placed 180° apart.

II. Photoelastic study:

A. Facilities of a completely equipped photoelastic laboratory.

B. Collapsible micarta cylinder in which flat ¼-in. bakelite plates were threaded to standard thread and joint dimensions, using regular chasers.

C. Carefully selected, commercially produced 5½-in. and 5-in. couplings from which four windows had been cut, leaving four ¼-in. ribs spaced at 90°, very accurately machined.

D. Especially designed gripping equipment to adapt speciment to straining frame.

Tension-leak testing: The casing speciment was tested—first at 400 lb. per sq. in., then at 1,000 lb. per sq. in., nitrogen pressure—with no tension in the joint other than that developed by gas pressure against the bulkheads. No leakage was found in this step. Tension loading was begun at a rate of 20,000 lb. per minute with 400 lb. per sq. in. pressure in pipe while the load was being applied. Short stops were made at 20,000-lb. increments, and prolonged stops at loads corresponding to 50 and 100 per cent of the published average setting depths in tension. During these intervals the pressure was built up to 1,000 lb. per sq. in., and the trough very closely examined for leakage. As no leakage was found up to or at this stage—except for two joints listed as having unusual make-up practices—loading was continued at a slower rate until the leak point was found. After leakage had been established, pressure was exhausted from the pipe, extensometers checked and removed, and the joint pulled to destruction. As gas pressure against the bukheads built up a load additional to that developed in the tensile machine, all readings taken while the pipe was under pressure were corrected to the higher figure.

Several variations in loading procedure were used. A number of joints were subjected to repeated loading under the yield strength; others alternated at or just over the yield strength. None of these practices affected the leak resistance and, therefore, were discontinued.

The trough around the coupling was watched carefully at all times for adhering or flowing bubbles. Lighting conditions were good, and the use of slightly soapy water exaggerated any bubbles so that leakage was detected quickly. Sudden, rapid escape of gas clearly defined the leak point. Even in the case of the four joints in which slow leaks were encountered early in the loading rapid leakage developed at higher loads, indicating that a definite "leak point" existed also in joints of this type. Rate of leakage—once this leak point had been reached—did not diminish with time nor with higher tensile loads. With the exception of a slight hesitation at the first escape of gas from several joints, there were no breaks in the flow.

Elongation of the joint in tension: Elongation readings were taken at 10,000-lb. increments. From these figures and the stress (based on the load applied, divided by the cross-sectional area under the root of the last-engaged thread) stress-strain diagrams indicating the proportional limit, leak point, and ultimate pullout load were drawn for the individual test specimens. From these an average curve was drawn, showing the maximum, minimum, and average leak resistance placed on the curve according to stress. In the first several tests, employing one dial gage on the extensometer, it was noted that some of the curves were irregular. A second gage was placed at 180° to the first. With this change, it was apparent that the joint elongated in either of two ways:

A. Uniformity at both gages, although one gage was often slightly behind the other; or

B. Irregularly on both gages.

The joints appeared to be "rocking" in the latter case, first one side and then the other moving under tension. In plotting elongations vs. stress, however, these irregular readings averaged into smooth well-defined curves.

Determination of yield strength of the joint: Yield strength normally is determined by either the 0.2-per-cent offset or the 0.5-per-cent total-elongation method. To determine the yield strength of a casing joint from the stress-strain diagram, it is necessary to assume a gage length, i.e., the length of section elongating effectively in the test. A threaded joint is a complex assembly with only the roots of the pipe threads logically subject to any degree of elongation. These, in most cases, definitely are restricted in movement by the coupling threads. The angle of the elastic section of the stress-strain diagram differs appreciably from test to test. This indicates either that:

A. The sections elongating under tension load are of different length; or

B. Some of the stress is being absorbed within the joint, and elongation is not taking place.

Observations made during testing led to the belief that the major part of the elongation was taking place in either of two sections:

A. Nonengaged and imperfect threads, about ⅝ in. over all; or

B. Nonengaged and imperfect threads, plus the last three engaged threads, about 1 in. over all.

Assuming 1-in. gage length, an 0.2-per-cent offset to the elastic portion of the diagram was drawn in, and its intersection with the stress-strain curve taken as the yield strength—the point being located in the knee of the curve. This means of finding the yield strength is in keeping with

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standard methods, and provides uniformity of determination throughout the program.

In this investigation the most important factor in leak resistance appeared to be the tension yield point of the section under the open root of the last-engaged pipe thread. However, four factors other than the yield strength of the steel affected the yielding of casing joints:

A. Short length subjected to elongation.
B. Stress concentration.
C. Preloading.
D. Development of secondary stresses in a radial direction.

The influence of these factors on the yield strength of casing joints must be recognized.

Safety: The restriction of pressures to 400 lb. per sq. in. during loading, and to 1,000 lb. per sq. in. under static load, was imposed as a safety measure because the tests were made in an open laboratory. The choice of nitrogen gas similarly was dictated because of the dangers inherent with either inflammable or combustion-supporting gases. The plugging of the inside of the pipe with soft-wood rounds limited the volume of gas under pressure and, therefore, its possible destructive force. Removal of pressure, once definite leakage had been established, was also a safety precaution.

Photoelastic tests: Inasmuch as tension and makeup introduce stresses into the casing joint, photoelastic analysis was made to determine the distribution of stresses and their possible relationship to the leak problem. Models were made

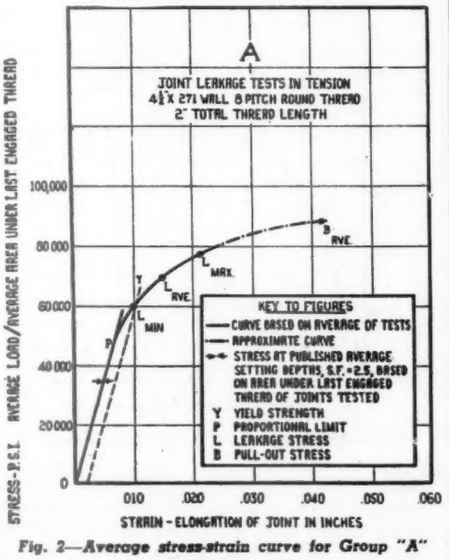


Fig. 2—Average stress-strain curve for Group "A"

from ¼-in. flat plates of bakelite—chosen for its optical sensitivity. The plates were machined to standard thread and joint dimensions by clamping the plates longitudinally between divided, half-round micarta blocks and cutting them with standard chasers on a precision lathe. This practice duplicated actual pipe threads even to the runout of the imperfect threads. Machining stresses were avoided by using very light finishing cuts. The threaded micarta assembly containing the bakelite plate then was screwed into the especially prepared coupling until the plate was parallel to two of the four ribs. The collapsible cylinder was removed, leaving the bakelite section engaged in the coupling—with the desired amount of makeup regulated by the original pullup of the cylinder into the coupling. The madeup model was placed in the straining frame, load applied as desired, polarized light passed through the specimen, and photographs made of the stress patterns. Monochromatic light was used, and black and white patterns obtained.

It was recognized from the start that the method of photoelastic analysis of stresses in casing joints used in this program would give only qualitative results. One of the main difficulties encountered was the duplication of stress conditions present in a threaded tubular section in tension. Using a slotted end-supported model did not answer the requirements, but did develop some interesting results. The use of a slotted model without end support was impractical. The investigation, therefore, returned to the solid bakelite plate.

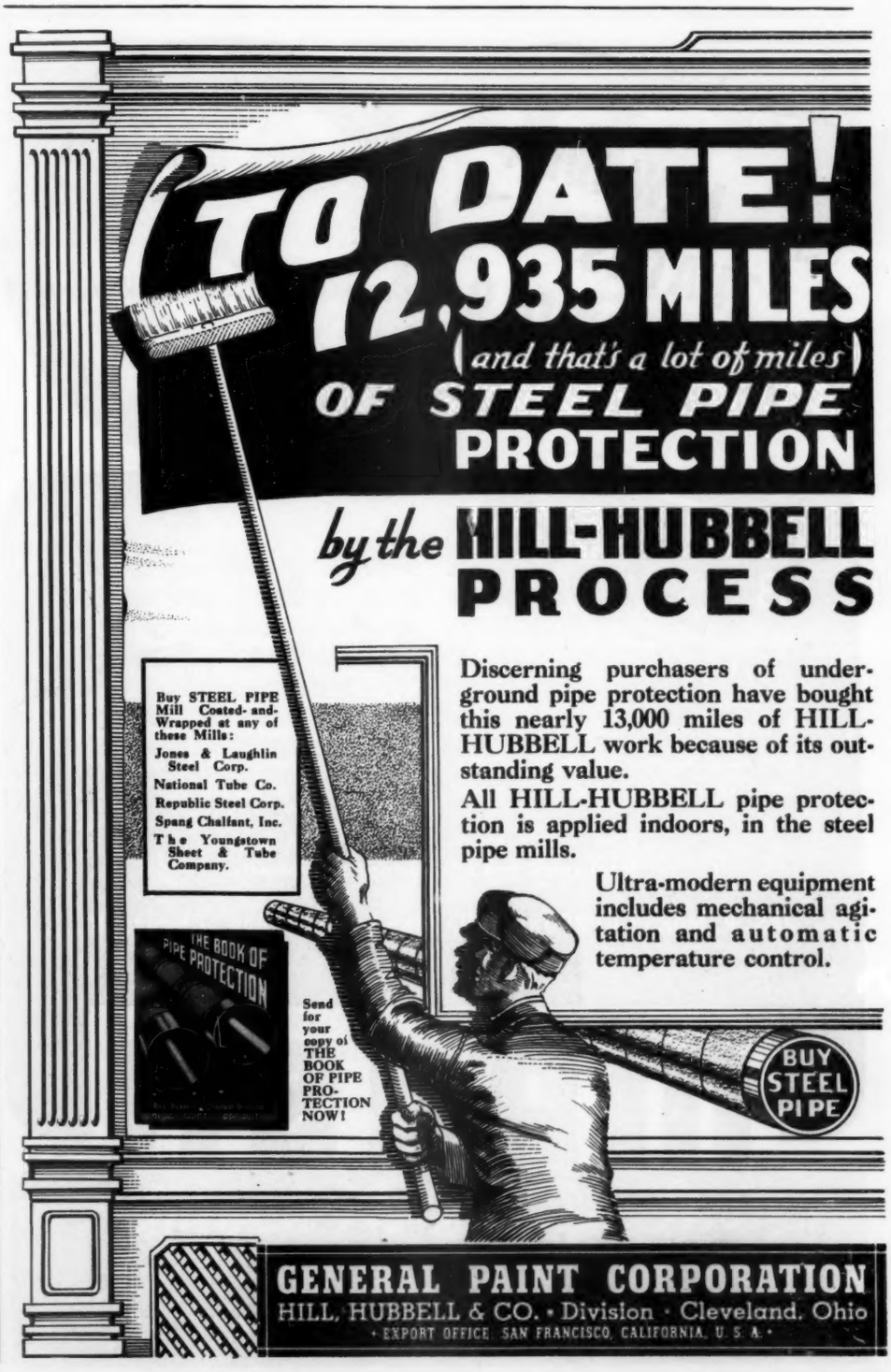
Test Results

Leak resistance in tension: Stress-strain diagrams of the individual casing specimens and those drawn to show the average curve of each group of tests (Figs. 2 and 3) illustrate the development of the leak points in relation to tension stress and to the significant tension points: elastic range, proportional limit, yield strength, and ultimate pullout strength of the joint. Results of the leak tests in tension, as shown graphically, indicated the 8-pitch round-thread casing joints have the following characteristics:

A. A definite "leak point" or "leak stress," at which the threads in the joint separate in such a way and to such an extent that rapid leakage develops in a previously tight joint.
B. Leak resistance in tension beyond that required in service.
C. Leak resistance in tension up to or beyond the proportional limit, and in most cases beyond the yield strength of the joint.

The existence of a well-defined leak point was noted in all specimens tested.

There are four exceptions to the foregoing statements, the joints leaking slowly at relatively low stresses. Above the proportional limits and yield point, however, rapid leakage set in at well-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defined points corresponding to the leak stress in other joints. These examples show that leakage may occur previous to attaining the leak point; but, as in these cases, the reason lies in factors other than the tension applied. The premature leakage of these specimens can be attributed to the irregular makeup practices used.

That the round-thread casing joint has a leak resistance beyond that required in service is evident. Ability to hold pressure at stresses developed by the weight of a string representing the published average setting depth in tension (safety factor = 2.5) was taken as the criterion of performance in service. All specimens exceeded this point except two. The standard selected is a reliable point to use in measuring possible damage done by the tension to which the joint is subjected in running. Actually, the operating tension stresses—under which casing carries internal pressure—are lower than the criterion.

In every specimen tested the leak point was higher than the proportional limit of the joint, and in only three cases did it fail to surpass the yield strength. Logically the leak point should occur at stresses higher than the proportional limit—and normally higher than the yield strength of the joint—because the opening of the thread channels depends upon distortion of the threads. It is readily apparent in the stress-strain curves that distortion through the elastic range is very low, and that no appreciable change in dimensions can take place until the proportional limit and yield strength of the joint have been exceeded. Minimum leak points are at or below the proportional limit shown on the average curves. The curves for the individual specimens show, however, that the leak points involved have exceeded their respective proportional limits and, in the case of one specimen, the yield point as well.

From the standpoint of the leak resistance in tension, all that can be asked of a casing joint is that it hold pressure up to its yield point or just to its proportional limit; because, once these points are reached, the joint no longer is mechanically stable. Any leak resistance beyond these points adds only to the leakage safety factor.

Effect of Various Factors on Leak Resistance

Length of thread, joint makeup, and differential in taper between pipe and coupling threads were found to have very definite effects on leak resistance.

Thread length: Four outstanding effects of longer thread lengths were noted:

A. Higher and more consistent leak resistance.
B. Greater elongation before leak point is reached.
C. Higher pullout strength.
D. Higher joint yield strength only on 7-in. sizes.

These differences may not be of practical significance, however.

On all sizes the long threads gave higher leak resistance than short threads. The full leak stresses of all long-thread specimens exceeded the yield strengths of their respective joints. One specimen leaked prematurely, but this was attributable to the coupling having been knowingly thrown out-of-round in making up the joint. To reach the leak stress, greater elongation was necessary in the long-thread joints than in the short-thread. The leak points of the former thus lay consistently further to the right on the stress-strain curves, without the tendency to crowd the yield point noted with the short-thread. The greater elongation indicated the ability of the long-thread casing joint to absorb higher tensile stresses, due to the distribution of the secondary forces, or hoop stresses, over a wider area than was present in the short-thread joints.

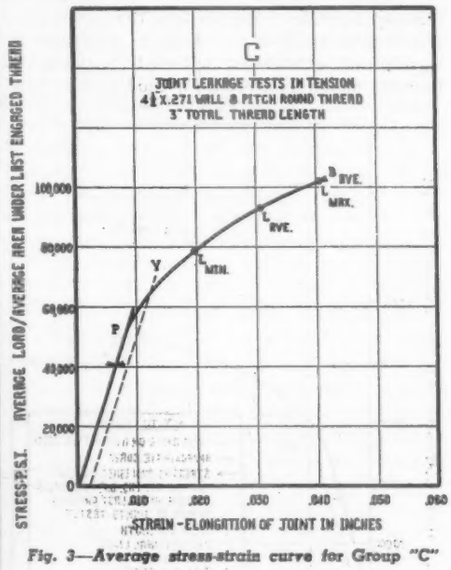

Fig. 3—Average stress-strain curve for Group "C"

Higher joint efficiencies on long-thread over the short-thread joints have been recognized for some time, and the data presented on that subject were incidental to the test. However, the same condition did not hold entirely for the yield strength of long-thread joints. Only on 7-in.-o.d., 26-lb. and 30-lb. casing sizes did the yield strength of the long-thread exceed that of the short-thread joints made from identical pipe. On the 4½-in. and 8⅝-in. tests no appreciable differences existed. The significance of this point lies in the possibility that any true advantage of the long-thread—both in tension and in leak resistance—may be limited to certain sizes, perhaps 5½-in. and 7-in. The leak resistance of the 4½-in. and

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8⅝-in. at least was obtained entirely in stresses past the yield point, and thus was of little practical value.

Joint makeup: Degree of makeup was found to have a marked effect on leak resistance, three threads being the optimum pullup. On either side of this figure leak resistance dropped off. The

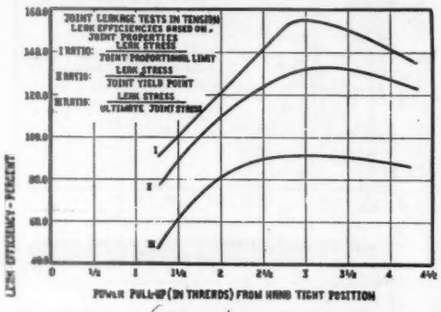
JOINT LEAKAGE TESTS IN TENSION
LEAK EFFICIENCIES BASED ON JOINT PROPERTIES
I RATIO: LEAK STRESS / JOINT PROPORTIONAL LIMIT
II RATIO: LEAK STRESS / JOINT YIELD POINT
III RATIO: LEAK STRESS / ULTIMATE JOINT STRESS
LEAK EFFICIENCY - PERCENT
POWER PULL-UP (IN THREADS) FROM HAND TIGHT POSITION

Fig. 4—Average curves for leak efficiency vs. makeup

results are shown graphically in Fig. 4—the curves being based on:

A. Makeup, as measured by the number of threads or turns the coupling was pulled up by power from its handtight position on the pipe threads; vs.

B. "Leak efficiency," the ratio of leak stress to:
   1. Proportional limit of the joint.
   2. Yield strength of the joint.
   3. Ultimate pullout strength of the joint.

Leak efficiency was used because it expressed relative leak resistance independent of the physical properties of the steel or the joint. First leaks, rather than full leak stresses, were plotted on these curves. Leak efficiency of the individual groups followed the trend of average curves quite closely. The curve based on ultimate joint strength gave the least scatter, whereas that based on proportional limit gave the widest band. The three average curves followed similar trends (Fig. 4)—all concurring on maximum leak efficiency at three threads makeup.

Makeup plotted against joint efficiencies showed correlation similar to that found with leak efficiency. Joint efficiency was based on the ratios:

A. Proportional limit of the joint to the proportional limit of the tensile-test coupon.

B. Yield strength of the joint to the yield strength of the coupon.

C. Pullout strength of the joint to the ultimate tensile strength of the coupon.

Curves *I* and *II* peaked at approximately three threads makeup, whereas Curve *III* tended more to flatten out at three threads pullup and higher. It is evident that degree of makeup definitely affects the physical properties of the joint and

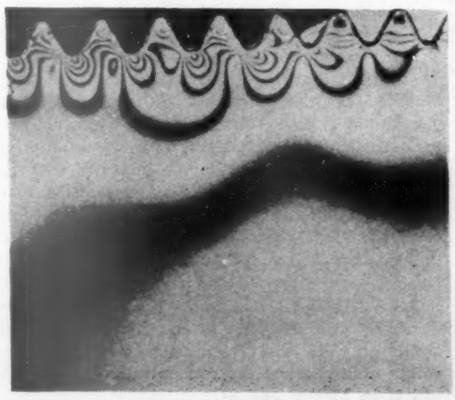

Fig. 5—Photograph of photoelastic fringes representing shear stresses in casing threads. Black section at top is steel coupling. Each fringe represents 175 lb. per sq. in. stress in the bakelite model

the ability to realize fully on the strength of the steel.

Taper differential: Taper differential between pipe and coupling threads lowered the leak resistance of casing joints unless there was sufficient makeup—three threads at least—to offset this influence. Curves for lower makeups peaked at zero differential. As makeup increased, the curves tended to straighten out—until at three threads pullup the curve for high pipe and low coupling taper was horizontal. The curve for 3½ threads makeup was likewise flat for the relatively lower pipe tapers. Leak stresses for the flat portion of the three-thread curve were higher than the 3½-thread, confirming generally the three-thread optimum makeup.

Photoelastic Study of Stresses in Casing Joints

Photoelastic analyses of the threaded models showed the following conditions (Figs. 5, 6, 7 and 8):

A. Stresses highly concentrated at the roots of the last four engaged threads.

B. Maximum stress present at the open root of the last-engaged thread, second highest stress at closed root of last-engaged thread.

C. Minor stress peak existing near the middle of the threaded section.

D. Stresses decreasing from middle of the threaded section to the end of the pipe, actually running into several "dead" threads on the long joints.

E. Stresses generally higher on one side of the model than the other.

The existence of stress concentrations explained the pitch and taper deformation in tension centering about the last-engaged thread, and emphasized the importance of this section in determining both leak resistance and joint strength. Concentration

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of stresses resulted in localized yielding, even though the yield strength of the full section involved had not been reached. Any factor which minimizes stress concentration will improve the strength of the joint.

The second and lower stress peak was probably the result of either:

A. Off-pitch threads matching in the center, as noted in mating off-pitch pipe and coupling threads.

B. A secondary fulcrum beyond which the threaded section collapsed but remained closely parallel to the coupling thread.

The model threads were very accurate, and matched the pitch of the steel coupling within 0.0005 in. The primary fulcrum in thread distortion existed at the last-engaged thread; and at this point taper of the pipe threads was increased by makeup and tension stresses, as contrasted with very little change in taper beyond the secondary fulcrum. The irregular distribution of stresses from side to side explained the "rocking" of the joint under tension.

Effect of thread length on stresses: Thread length had two marked effects on distribution of stresses in casing models:

A. Less concentration of stresses at the open root of the last-engaged thread in the long joint (*A*, Fig. 6).

B. Stresses relatively high to the end threads in short joints, but falling off to zero in the long joints, even running into negative stresses (Fig. 6).

The presence of lower stress concentrations in the long-thread joints indicated that there was an advantage for long threads in joint yield strength and leak resistance. This was exhibited in the 7-in. long-thread joints. The tendency of the long joint to develop dead threads, i.e., zero or negative stresses, showed that several end threads in long joints were carrying no effective load.

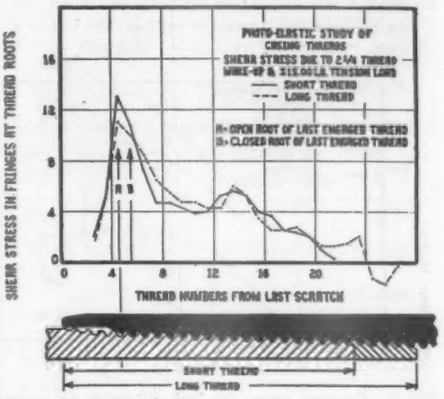


PHOTO-ELASTIC STUDY OF CASING THREADS
SHEAR STRESS DUE TO 2¼" THREAD MAKE-UP & 315,000 LB. TENSION LOAD
SHORT THREAD
LONG THREAD
A=OPEN ROOT OF LAST ENGAGED THREAD
B=CLOSED ROOT OF LAST ENGAGED THREAD
SHEAR STRESS IN FRINGES AT THREAD ROOTS
THREAD NUMBERS FROM LAST SCRATCH
SHORT THREAD
LONG THREAD

Fig. 6—Stress distribution of long-thread vs. short-thread joint

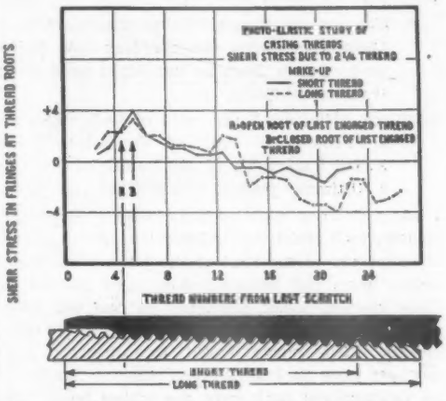


PHOTO-ELASTIC STUDY OF CASING THREADS
SHEAR STRESS DUE TO 2¼" THREAD MAKE-UP
SHORT THREAD
LONG THREAD
A=OPEN ROOT OF LAST ENGAGED THREAD
B=CLOSED ROOT OF LAST ENGAGED THREAD
SHEAR STRESS IN FRINGES AT THREAD ROOTS
THREAD NUMBERS FROM LAST SCRATCH
SHORT THREAD
LONG THREAD

Fig. 7—Makeup stresses in long and short-thread joints

Effect of makeup on stresses: Study of makeup indicated the following effects on stress conditions in the models:

A. Existence of shear stresses of the same sign as tension—therefore, additive—in the section from the middle of the thread length to the last scratch (Fig. 7).

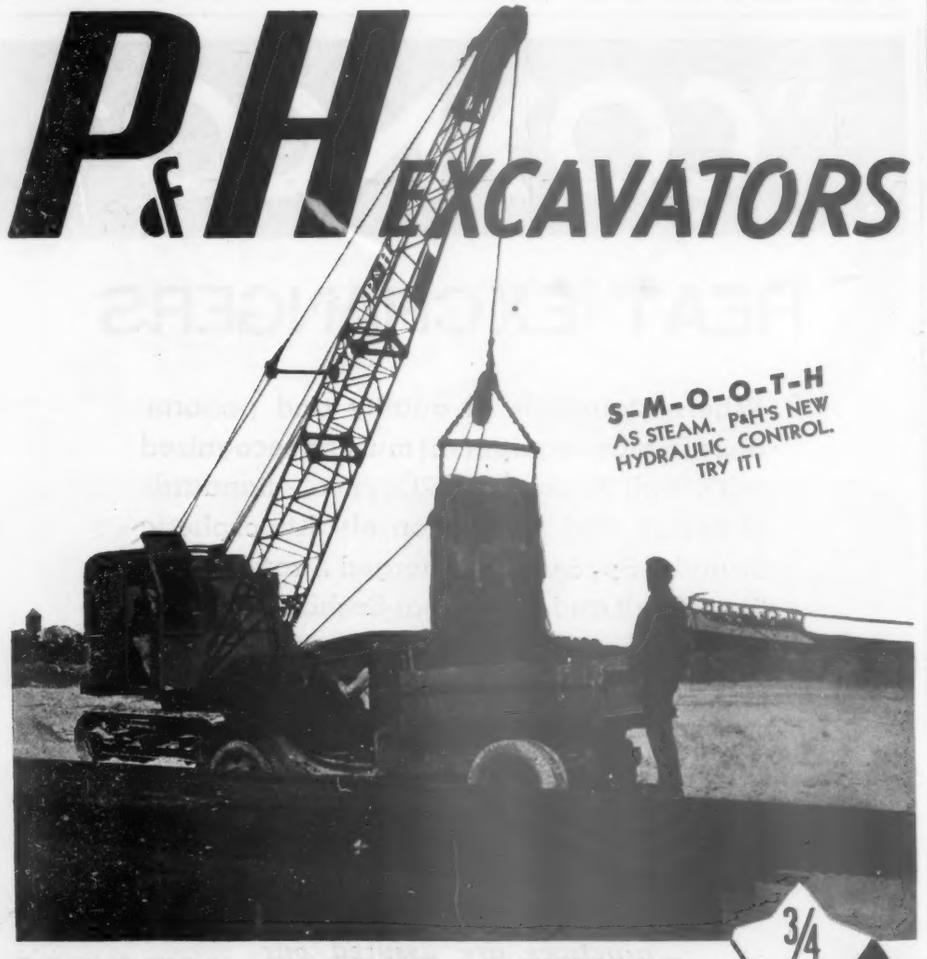
B. Maximum concentration of makeup stresses under the closed root of the last-engaged thread (*B*, Fig. 7).

C. Maximum concentration of tension stresses under the open root of the last-engaged thread, with uniform distribution of stresses after the last four engaged roots (*A*, Curve *III*, Fig. 8).

D. Existence of shear stresses of a sign opposite to tension from the middle of the threaded section to the end of the pipe (Fig. 7).

The similarity of tension and makeup stresses in the last-engaged thread area was confirmed by the fact that distortion of threads in makeup was in the same direction, although less than that found in pulled-out joints. With tension and makeup stresses being additive, the possibility of preloading and overloading a joint by makeup was demonstrated. In the tension-leak tests, leak efficiency fell off with makeups over three threads. The lowered leak resistance was explained by the combined makeup and tension stresses preloading the casing specimens sufficiently to cause yielding at reduced loads. Consequently, lower leak points and joint efficiencies developed. The early yielding took place at the points of highest stress concentration (Points *A* and *B* in Figs. 6 and 8).

The essential difference between tension and makeup stresses lay in the point of concentration—tension stresses concentrating under the open root (*A*, Curve *III*, Fig. 8), makeup stresses



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under the closed root of the last-engaged thread (*B*, Fig. 7). With this difference present, the maximum stresses produced by each were not directly additive, but the similar stresses combined with each other directly according to the stresses that existed at identical points (*A*, *B*, Curves *I* and *II*, Fig. 8).

The stresses introduced into the models by applied tension load alone peaked sharply under the open root of the last-engaged thread (*A*, Curve *III*, Fig. 8), gradually diminished along the adjoining four roots, and then held at a reasonably uniform distribution out to the end thread. However, the combination of these positive stresses with the negative stresses developed in makeup (Fig. 7) resulted in progressively lower intensity toward the end of the threads. Dead threads were produced when the negative makeup stresses equalled or exceeded the applied stresses. Increased makeup reduced the number of dead threads. This reflected the tendency of increasing makeup to produce more uniform stress concentration.

Taper differential: On a preliminary model, with a taper differential of 0.003 in. between bakelite model and coupling, it was noted that four dead threads developed, as against two or three on the regular models, with very accurate taper. This condition could be overcome by additional makeup on the model (Fig. 8).

Summary

A. Leak tests in tension show that the eight-pitch round-thread casing joints have leak resistance in tension beyond that required in service. Yield strength of the joint appears to be the controlling factor in leak resistance, and the full leak stress is essentially a physical property of the joint. Premature leakage can, and does, occur; but the explanation for this lies in factors other than the tension applied.

B. Long-thread joints give higher leak resistance and joint strength. The true value of this extra tightness and strength is open to question, because it could not be shown definitely that it was accompanied by higher joint yield strength. There is evidence to substantiate the belief that an intermediate thread length is desirable, because it will retain in large part the extra leak resistance and strength of the long joints without the heavier stress concentrations present in the short threads.

C. Degree of makeup is a critical factor. The most desirable makeup is 3 threads, or a range 2½ to 3½ threads. Either side of the optimum figure results in lower leak resistance and joint efficiencies. Makeup practices are very important.

D. Taper differential in either direction lower leak resistance, but this tendency can be overcome by proper degree of makeup, averaging three threads pullup.

E. The photoelastic method is a very useful tool for studying stresses in casing joints. The casing-thread problem is ideal for three-dimensional analysis in which actual threaded tubular sections can be studied. Further investigation of large thread models also would be enlightening.

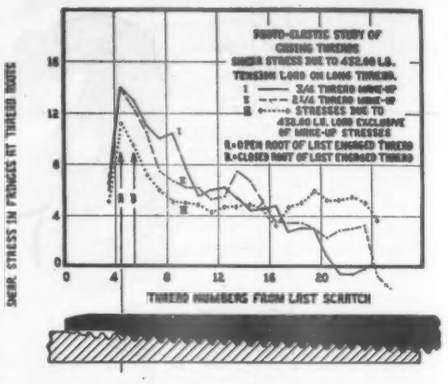


PHOTO-ELASTIC STUDY OF CASING THREADS
SHEAR STRESS DUE TO 432.00 LB. TENSION LOAD ON LONG THREAD.
1 —— 3/4 THREAD MAKE-UP
2 - - - 2 1/4 THREAD MAKE-UP
3 ·—·—· STRESSES DUE TO 432.00 LB. LOAD EXCLUSIVE OF MAKE-UP STRESSES
A = OPEN ROOT OF LAST ENGAGED THREAD
B = CLOSED ROOT OF LAST ENGAGED THREAD
SHEAR STRESS IN POUNDS PER THREAD ROOT
THREAD NUMBERS FROM LAST SCRATCH

Fig. 8—Total stresses in joint; stresses due to tension load alone

Acknowledgment

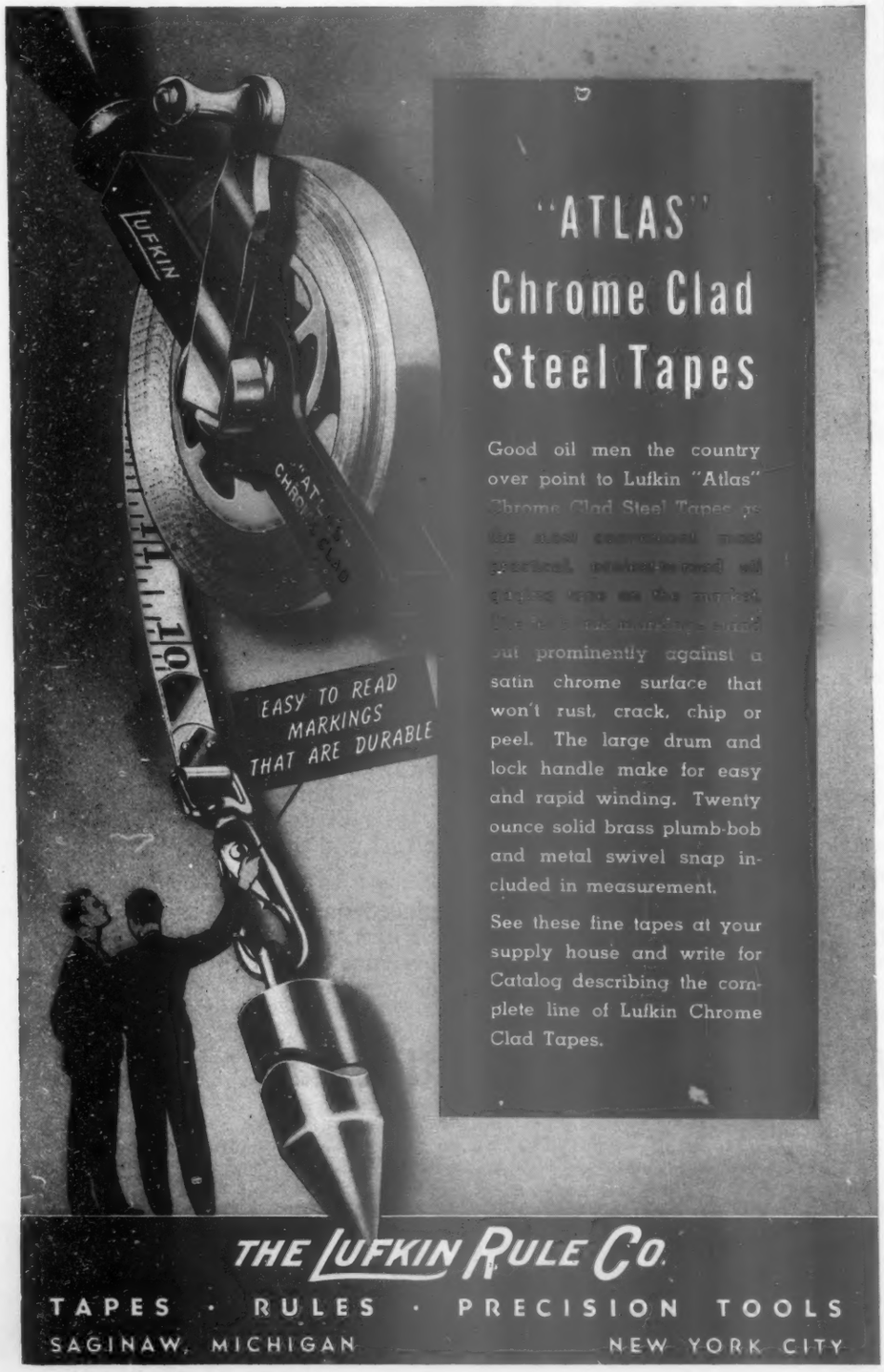
The authors wish to express their appreciation to the following:

Gould Coupler Corp., Depew, N. Y., for the use of their physical testing laboratory; Dr. M. M. Frocht, of Carnegie Institute of Technology, Pittsburgh, Pa., for conducting the photoelastic study; various members of the authors' organization, for their cooperation.

The help given and interest shown by the numerous persons involved in this investigation were of the highest order, and aided very materially in the successful execution of the program.

Bureau of Mines Report on Water-Encroachment Investigation

Results of experiments aimed at a better understanding of water encroachment in oil-bearing sands and rocks have been published in Bureau of Mines R.I. 3595, "A Laboratory Study of Water Encroachment in Oil-Filled Sand Columns," by Frank G. Miller. The study to date reveals that under certain idealized laboratory conditions and within a range of water movement of the same order of magnitude as rates of edgewater encroachment in oil-bearing structures the percentage of oil recovered increases with the rate of water movement.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Causes and Prevention Of Drill-Pipe and Tool-Joint Troubles

By R. S. GRANT and H. G. TEXTER
Hughes Tool Co., Houston, Tex. Spang Chalfant, Inc., Tulsa

THIS paper outlines practically all the principal types of drill-pipe and tool-joint failures. When the cure is known, practical ways of eliminating the trouble are explained in detail. When no complete cure has been found, acceptable ways of reducing the trouble are explained, if known. The paper is based upon many years of experience in the study of drill-stem failures by the writers and by their operator friends.

The plan of this paper is to discuss drill-pipe and tool-joint failures, point by point, taking up the more obvious troubles first and then proceeding through the more obscure causes of failures. To complete the picture it is thought worthwhile to include brief discussions of early troubles—even though they now are almost nonexistent—with modern manufacturing and drilling practice.

As a matter of information, references to pertinent papers are given in the bibliography.

Drill pipe is discussed first, because its varieties of troubles are more numerous.

Drill Pipe

1. True twistoffs.

The term "twistoff" is used, erroneously, in the field for any type of failure in which the pipe becomes broken, or parted for any cause whatsoever. Its true meaning should be a failure of drill due to pure torsion.

In the early days of rotary drilling, when fishtail-type bits were used almost exclusively, and when drill pipe was made of softer steel, failures resembling true twistoffs occasionally occurred when the bit got caught and the table continued to rotate. Even under such circumstances, the failure is not one of pure torsion; because the pipe, being unconfined, could buckle and "wrap up" before parting.

Today rock bits are used, except in relatively soft formations, and bits almost never hang up so abruptly that the table cannot be stopped before failure occurs. Also, drill pipe seldom is manufactured in softer than Grade D steel, and its torsional strength is so great that it cannot be "wrapped up" by the torque exerted in ordinary drilling.

2. Spiral tears.

Spiral tears also represent a type of failure which is practically nonexistent today, and which at no time was very common.

A spiral tear is another form of torsional failure occurring when the bit gets hung up and the table continues to turn. It could happen only if the pipe were rather closely confined, inside of casing—and then only if there already had been a transverse crack or deep transverse scratch in the body of the drill pipe. With such conditions, under heavy torsional stress, the crack or scar tears into a very uniform spiral. The spiral is always right hand (for right-hand table rotation) and bears no relation to any possible lines of weakness in the body of the pipe. In fact, modern seamless drill pipe is so manufactured that any lines of weakness are in a slow (long-pitch) left-hand spiral.

3. Tension failures.

Before the days of dependable weight indicators it was fairly common to part stuck strings of drill pipe. The lower tensile strength of earlier drill-pipe steel was, of course, a contributing factor.

The parting of stuck strings of drill pipe represents pure tension failures, preceded by an appreciable necking down of the weakest length, somewhere near the top of the string.

Even today, when drill pipe is stuck, it sometimes will be pulled on beyond the yield point in desperation, or because the weight indicator is out of adjustment. Naturally, however, it is seldom actually parted.

If a drill string is suspected of having been pulled beyond the yield point, all the upper part should be examined closely to see whether the lengths have been stretched. This can be done by comparing the "before and after" length tally or by checking the outside diameter with calipers. Dangerous elongation can be detected readily, and such lengths discarded.

However, it is hard to define "dangerous" elongation. One operator has reported stretch in a stuck string amounting to 2 ft. per 30-ft. length. After having discarded only a few lengths in which he could determine a necking down on the diameter, the remainder of the stretched pipe gave satisfactory service. Undoubtedly such lengths were considerably work-hardened as in cold-drawn wire, and would be less ductile than normal pipe. Also, there is danger that the stretch has not been as uniform as it seems, which would give an area of very low ductility. So, it would be good practice to discard all stretched lengths, or at least to degrade them to less severe drilling.

When drilling at depths of 10,000 ft. and deeper, danger of tension failure can be minimized by using heavier-weight drill pipe in the upper part of the string, or by buying special high-tensile pipe of better than Grade D physical properties.

Also, because of danger of mixing pipe, the upper part should have a larger outside diameter as well as being heavier. Combination strings such as the latter actually are being used in California.

Once in a very great while drill pipe will fail from tension after partly having failed from another cause, such as bending fatigue, for example. In such a case there will be a section of the break in which the wall is of normal thickness, with an almost square fracture, but with the balance necked down and elongated irregularly as in the case of pure tension. Usually, however, a fatigue crack continues to tear after it once has started.

4. Last-engaged thread failures.

When A.P.I. tool joints are screwed onto A.P.I. pipe, with sufficient torque to insure against leakage or unscrewing, and when this madeup element is subjected to bending or vibration stresses, as in drilling, there are almost certain to be many fractures through the upsets. These fractures invariably start as transverse cracks, at the bottom of the last-engaged thread of the pipe (counting the thread at the small end of the pipe as the first thread). The crack is the result of stress concentration due partly to the compressive effect of the tool joint concentrated at the bottom of a notch (thread), and partly to the resistance to bending imposed by the relatively heavy mass of the tool joint which is gripping the pipe.

The rapidity with which last-engaged thread cracks develop is determined by the frequency of stress reversals—which, in turn, is governed in part by the speed of rotation. This type of failure seems to be affected mostly by vibration, as the trouble is encountered almost exclusively in rock-bit drilling; but occasionally occurs in

A.P.I.

ABSTRACT

The authors describe drill-pipe and tool-joint troubles and means of preventing them.

It is stated that true twistoffs, spiral tears, and tension failures have been practically eliminated by improved pipe manufacturing and drilling practices. Failures at the last-engaged thread and leakage through threads also have been practically eliminated through improvements in design and in installation methods.

Fatigue breaks are the most common type of drill-pipe trouble today. They may be pure fatigue failures, but more often are accelerated by notches or scars and by corrosion. Fatigue breaks may be reduced greatly by the use of adequate drill-collar weight, and this is probably the most important recommendation that can be made to increase the life of drill pipe.

Troubles arising from worn pipe best can be prevented by keeping the pipe straight. Pipe usually is made crooked by running the string in compression. Collapsed pipe, although rare, usually occurs while making drill-stem tests.

Wall eccentricity, internal erosion, and magnetism, although often discussed, have never been proved to be causes of drill-pipe failures.

Longitudinal splitting of the pipe ends of tool joints has been practically eliminated by the use of upset forgings. Splitting or swelling of the pin and box ends can be prevented by the use of special lubricants.

Galling and wabble failures are the two most common tool-joint troubles today. The former best can be prevented by careful breaking in and adequate lubrication.

Wabble failures result from operation of the joint while loose, and aggravated by the modern practice of running drill strings in tension. They best can be prevented by adequate tonging and by care in handling to prevent damage to shoulders.

Tool-joint wear cannot be prevented, but the effects and costs entailed can be minimized by the use of easily replaceable tool joints, oversize tool joints or wear subs, and by resleeving or hard-surfacing of either the tool joints or subs.

This article is an extended digest of the original paper, which was presented before the Division of Production at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7. A number of the figures have been omitted. The remainder of the article will appear in the November 13 and November 20 issues.

fishtail drilling, immediately above the drill collar, when there is considerable bending from the pipe being in compression.

In further proof that vibration is a major factor in this trouble are the following facts:

Straight holes give more trouble than crooked ones. In fact, last-engaged thread failures were never very serious until straight-hole specifications were put into drilling contracts. Crooked holes, evidently, damp the vibrations.

Drilling inside large outside-diameter surface casing causes more failures than in smaller casing.

Also lighter muds, or clear water, give more trouble than viscous drilling fluids, the latter having more damping effect.

A surprisingly large precentage of these failures occurs under the box ends of tool joints—which seems to mean that vibrations, traveling up from the bit, momentarily are halted by the heavy weight of the box tool joint and produce stress reversals at the root of the last-engaged thread.

These failures are most numerous when the drill pipe is in at least occasional compression, but often occur far up in a string where the pipe is always in tension.

A few isolated cases are known of last-engaged thread failures that apparently have been caused during straightening of short kinks in drill pipe just above the point where gripped by the rotary slips. This might be due to one of the straightening-machine anvils having been placed on the end of the tool joint; but it is not certain whether the bending stress, thus imposed, actually caused the failure or simply aggravated a crack already started in drilling service.

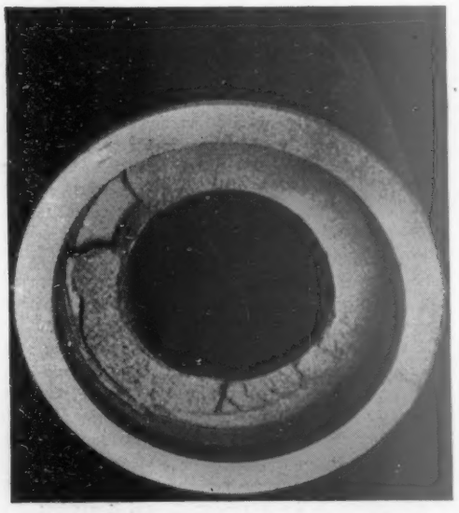

Fig. 1—Complete failure in last-engaged thread

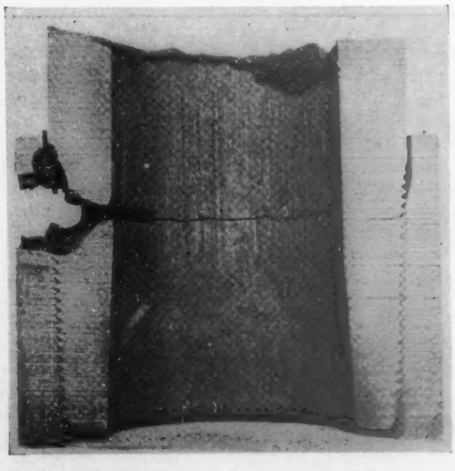

Fig. 2—Incomplete failure in last-engaged thread, showing effect of mud cutting

Last-engaged thread failures are aggravated by corrosion, and many persons believe that this is the most important factor of all. In part proof of this point is positive elimination of the trouble by the very light bead of metal now employed in welding the tool joints to the pipe. The mechanical strength of the weld cannot be high, but it does keep all corrosive fluids away from the first exposed thread root.

Figs. 1 and 2 illustrate last-engaged thread failures, both as they occurred and as sectioned in the laboratory. Sometimes, as in Fig. 2, the break has not proceeded entirely around the pipe, but has allowed mud to cut through and erode holes through the tool joint.

Today there are many patented drill-pipe tool-joint connections on the market in which the effect of a stress-concentration point at the root of a thread has been eliminated. Some of these bridge over the last threads of the pipe by allowing the tool-joint recess to land on a machined surface on the pipe, beyond the threads. Some connections effectively employ square threads which eliminate the notch effect of A.P.I. threads. Others eliminate a threaded connection altogether by making the tool joint integral with the pipe, as by upsetting or by welding.

All of the designs, including welding the tool joints to the pipe, have eliminated last-engaged thread breakage to such a large degree that it may be considered as a thing of the past, and this phase of drill-pipe trouble well may be relegated to ancient history.

5. Leakage through threads.

Also as past history may be included leakage between drill-pipe and tool-joint threads. Aside from having been practically eliminated by the greater accuracy of modern A.P.I. threading specifications, the general practice of having all tool joints screwed on in a mill, or shop, and of welding the tool joints to the pipe, plus the introduction of patented connections, eliminates leakage entirely as a present-day trouble.

6. Fatigue breaks.

Fatigue breaks are by far the most common drill-pipe failures known both in early and present drilling practice. However, they are often the least understood by those in the field.

For one thing, the field classification of this general type of failure is incorrect to start with. If the failure is incomplete, i.e., when a fatigue crack does not travel on around to complete failure, but is discovered as a hole in the pipe, it is called a "washout"; and when it is a complete failure, a square break, or nearly so, it is called a "twistoff." Not only are these terms erroneous, but they definitely mislead the observer as to the cause.

Long study of field troubles has led to one very positive and invariable conclusion: that there cannot be a "washout"—in the sense that the drilling fluid has cut its way through the wall of the pipe—without there being some sort of starting hole. Therefore, a "washout" is not a hole washed out through pipe, but is a crack (usually a fatigue crack) which has formed under mechanical stress, but which has been enlarged and rounded off at the edges by the eroding action of the mud stream.

All drill pipe is made by the seamless process, and the very nature of this piercing process is such that a defect in the billet which would result in a hole entirely through the wall is a physical impossibility. The expansion force required to convert a solid steel billet into a tube by piercing is great enough to tear open even a minor defect in the billet—and, instead of a tube, it would emerge from the piercing mill as a ribbon. Actually the seamless process is the most effective method ever discovered of inspecting large tonnages of steel. Thus there are several reasons for being positive that all "washouts" are simply enlarged fatigue cracks.

Another erroneous impression in connection with fatigue is the idea that the steel has "crystallized." Actually there has been no change whatsoever in the size of the crystals. They simply have broken down, across their crystal planes, and the resultant fracture has a "brittle" appearance to the naked eye, which has led to the thought of "crystallization." Elsewhere, even at the very edge of the original crack, as well as at any other location in the failed length, the metal is perfectly normal except for a very small amount of work-hardening.

Fatigue breaks can be subdivided into three classes: (*a*) pure fatigue, (*b*) notch fatigue, and (*c*) corrosion fatigue. Of these the first one is the least common.

(6-a) *Pure fatigue.*—Whenever steel is subjected to cyclic stress of sufficient magnitude—whether in tension, compression, torsion or bending—it will fail ultimately by fatigue fracture. Inasmuch as bending and direct tension are by far the most common critical stresses applied to drill pipe, they alone need be studied in detail.

The simplest illustration of bending fatigue is that of breaking a nail by gripping it in a vise and bending it back and forth with a hammer. Anyone knows that the further it is bent, at each blow, the sooner it will break. But what is not known by everyone is that hammer blows which do not put a permanent bend in the nail may still break it if repeated often enough. However, if the stress set up by the hammering back and forth is below a certain figure—different for different grades of steel—the nail never will fail. This critical stress, measured in pounds per square inch, is called the "endurance limit" of that particular steel.

Thus, if an ordinary 0.10 per cent carbon-steel nail be bent back and forth so that the maximum stress is less than 28,000 lb. per sq. in, it may be bent back and forth billions of times without causing fracture; but if the stress is above this figure, the nail eventually can be fractured, and the number of times it need be bent (the number of stress cycles) decreases as the stress increases.

This is illustrated in Fig. 3, which is a simple

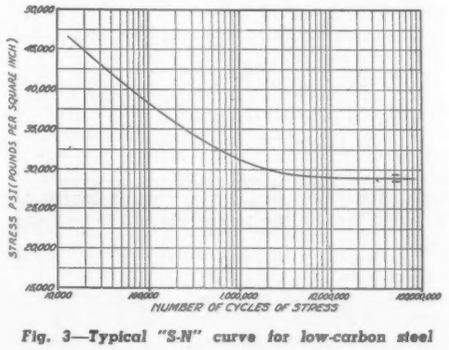

Fig. 3—Typical "S-N" curve for low-carbon steel

example of an "S-N" curve (stress plotted against number of stress cycles to produce failure). It shows that, if the stress is low enough, the nail never will break; but if the stress is raised to, say, 30,000 lb. per sq. in. the nail will fail at about 2 million cycles. If the stress is raised by 33,000 lb. per sq. in. the nail will fail at only 500,000 cycles; and if raised to the elastic limit, the nail will break almost immediately. Thus, only a few blows of a hammer are required to break a nail when it is bent back and forth in a vise through

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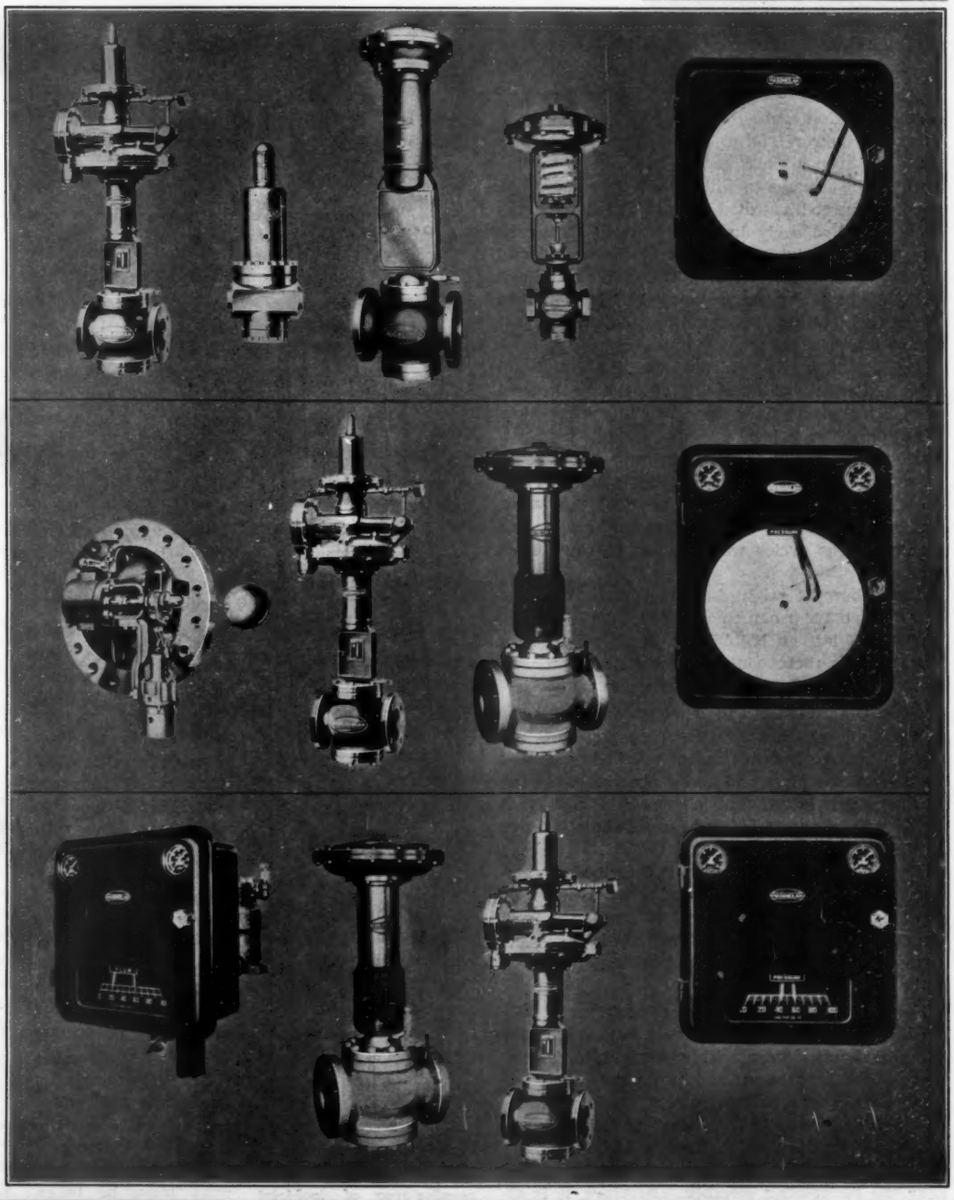

a considerable arc, because the stress is then above the elastic limit, or at least 48,000 lb. per sq. in. in Fig. 3.

Drill pipe can, and occasionally does, fail from pure fatigue; but this is rare, because other factors, such as outside scars or corrosion, are usually contributory.

Fig. 4 is an example of pure fatigue in 5-$\frac{5}{16}$-in.

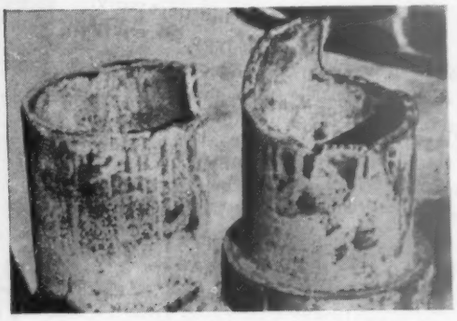

Fig. 4—Example of pure fatigue failure in drill pipe

drill pipe. The fatigue occurred in a new string of pipe—with rock-bit drilling—on its first well, and under circumstances which could be determined definitely and studied.

Drill pipe fails so seldom in its early life that a complete service history cannot be obtained. After the first well, the lengths lose their identity and their relative position in the string, so that not even a guess can be made as to the nature of the stresses to which they were subjected.

The failures illustrated were two of five lengths that failed so early in the first well that even much of the original outside mill scale could still be seen near the tool joints. Therefore, there was little doubt that all five never had been moved from their original position in the string, just above the drill collars.

Briefly, it was established definitely that all five failures were the result of bending stresses due to the pipe having been run in compression. The compressive load was not enough to put a permanent bend in the lengths, but was probably just short of that stress. In other words, on the "S-N" curve for this particular steel the stress was so near the elastic limit that only a very few million stress cycles were needed to cause fracture.

Right here it might be noted that drill pipe rotating at 100 r.p.m. makes 144,000 revolutions per day if left on bottom continually. Hence, in just 10 days there could have been more than a million cycles of whatever stress was imposed.

Once the fracture had started, mud began to erode and smooth over the sharp edges of the crack; but the fracture rather quickly proceeded on around the pipe, and ended up with a tearing action which left the lip shown in Fig. 4. This lip is very characteristic of pure fatigue failures in drill pipe.

Examination of the failures described hereinbefore disclosed no evidence of any corrosion, or scarring, or slip marks, or any surface defects which could have given a starting point for fracture. Hence the justification for calling this "pure" fatigue.

Further justification is the position of the breaks, with respect to the tool joints. All five of these breaks were within 8 to 10 in. of the tool joint (three boxes and two pins)—which is just about where bending stress would be highest. The tool joint is the "vise" and the pipe is the "nail," and just as in the case of bending the nail to failure the fracture occurs somewhere near the restraining member. Therefore, it is almost always true that failures from pure fatigue occur just beyond the upset runout, or from 7 or 8 in. to about 20 in. from either the box or pin tool joint.

Evidence that the pipe really was being bent back and forth is the rather remarkable peening over of the elevator shoulder which can be seen in Fig. 5. All three of the box-end failures showed this, and it is clear that this was caused by the

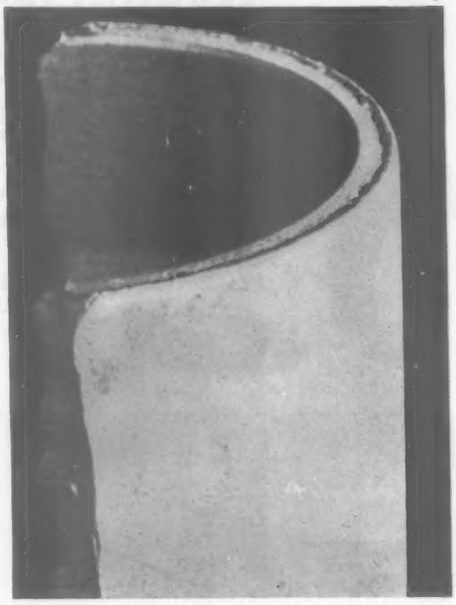

Fig. 5—Peened-over elevator shoulders due to drill string pounding back and forth in hole

lower end battering against the formations. And, because the tool joints were getting such a battering, the body of the pipe must have been swinging violently back and forth in the (9⅝-in.) hole, cocking the tool joints, shown exaggerated in Fig. 6, and setting up the bending-stress cycles which finally reached the endurance limit of the steel.

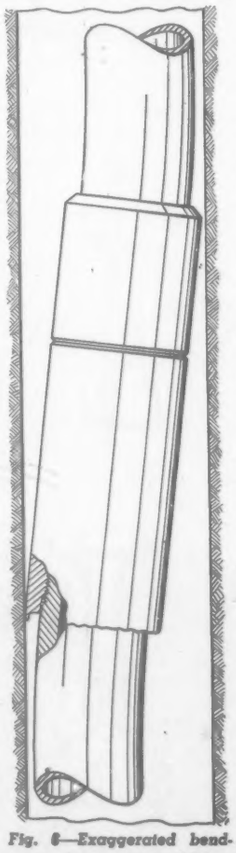

Fig. 6—Exaggerated bending of pipe, explaining peening-over of tool-joint shoulder

A remedy for the foregoing trouble is to keep the drill pipe definitely in tension, by adding enough drill collars to more than equal the maximum weight on the bit. This is exactly what was done with this 5-$\frac{5}{16}$-in. string, and the breakage stopped until several of the collars were removed. Then two more failures occurred, but again were stopped by the replacing of the collars.

In calculating the amount of drill collar needed to keep the drill pipe in tension, the buoyancy of the mud must be taken into account. In 9.4-lb. mud (approximately 70 lb. per cu. ft.), for example, steel loses about one-seventh of its weight. Or, a 7,000-lb. drill-collar assembly would weigh only 6,000 lb. suspended in the drilling fluid.

To have 15,000 lb. on a bit in a 9.4-lb. mud, the actual weight of the drill collars, reamers, etc., would need to be 15,000 lb. divided by six-sevenths, or 17,500 lb. In heavier muds the increased drill-collar weight needed would be proportionately greater.

But, using 17,500 lb. would place the neutral point (neither tension nor compression) right at the top of the drill collars, and there would be no leeway for errors in the weight indicator or for careless handling of the brake lever. Therefore, to insure that the drill pipe never would be in compression, good practice is to ignore the buoyancy of the mud but to run 50 to 100 per cent more drill-collar weight than the highest weight ever carried on the bit. Thus, for 15,000 lb. on the bit, in order to keep the drill pipe definitely in tension, the weight above the bit, drill collars, reamers, etc., should be 22,500 to 30,000 lb.

Occasionally pure fatigue failures seem to occur in the upper part of a string where the length of pipe always had been in tension. However, if all facts were known, it is more than likely that the length had formerly been run in compression, on a previous well, and had already reached the fracturing point. Also, it is pretty definitely established that a crooked kelly can cause bending in the first length of drill pipe, below the kelly sub, and might cause a fatigue failure. Even having the crown block off center would throw some bending stress in the kelly and pipe.

A final point in connection with fatigue is the relative resistance to failure of internal-upset and external-upset drill pipe. Inasmuch as it already has been pointed out that the tool joint (and upset end of the pipe) is the "vise" and the drill pipe is the "nail," it must be evident that the more immovable the vise the quicker the nail can be broken. Therefore, the larger and heavier the upset (and tool joint), the greater the stiffness of the restraining member will be, and the quicker the adjacent pipe can be broken. This fact is being borne out in the field, and indicates that internal-upset drill pipe is preferable to the external-upset designs unless the latter is needed for greater fluid passage. In other words, the lower the stiffness of the joint the less the danger of fatigue fracturing the pipe.

(6-b) *Notch fatigue.*—After understanding the mechanism of pure fatigue, it is very easy to understand the effect of surface imperfections. They just give the crack a good starting point.

Going back to the nail in the vise, we all know how much more easily it can be broken by filing a sharp nick in it, somewhere near where it will be gripped. In fact, if the nick is placed properly, right at the edge of the vise jaw, the nail can be broken off completely with a single sharp blow of the hammer—and the nick need not be very deep either. The only requirements are that it should be a transverse (circumferential) nick and rather sharp-bottomed. Incidentally, these are the conditions contributing to last-engaged thread breaks, discussed under Item 4 of this paper.

Notch-fatigue failures often are accelerated by corrosion, particularly when the notches are deep enough to allow the corrosion to progress, undisturbed by wear. However, corrosion usually proceeds from the inside of drill pipe, as will be discussed later.

Various surface defects which can, or do, result in notch-fatigue failures are noted as follows:

Screwon-machine grip marks.—When tool joints are screwed on, at the mill or in a field shop,

(Continued on Page 167)

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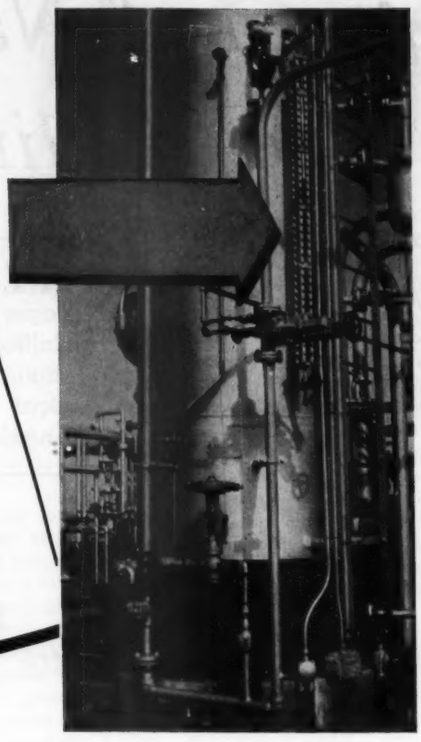

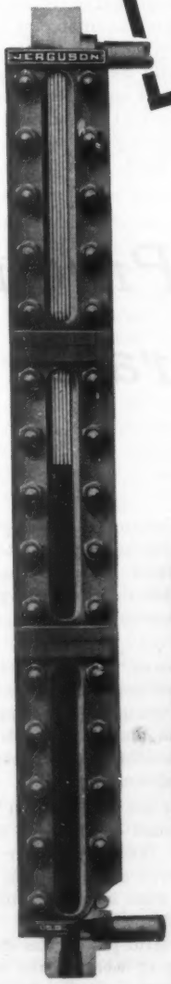

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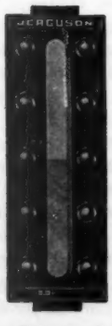

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Program of Natural Gas Use—California

By RAY L. RILEY
Commissioner, California Railroad Commission
State Building, San Francisco, Calif.

A.I.M.E.—Abstracted from paper presented at southern California section, American Institute of Mining and Metallurgical Engineers, meeting, Los Angeles, Calif., October 29-30.

THE major portion of California's gas supply presently distributed is the so-called casinghead gas, the rate of production being tied to the rate of oil production by natural law. The supply is therefore relatively inflexible.

Demands for gas is a combination of weather conditions, industrial working hours and other widely fluctuating factors, varying from hour to hour and from day to day over wide ranges. The principal problem is therefore efficient adaptation of a relatively inflexible supply to the fluctuating load. Minor problems of efficient utilization include:

(*a*) Providing adequate transmission facilities for peak gas production at newly drilled oil fields.

(*b*) Providing reasonably proportionate outlets for dry-gas fields to encourage their conservative development as standby producers in times of excessive demand.

(*c*) Providing reasonably equitable opportunities for all producers to market their gas proportionately in times of low demand.

Past practice has been to build pipe lines to transport the peak demand of domestic and commercial users, with a sufficient cushion to cover unusual weather conditions. Adjustments to fluctuating loads are met in part by one or more of the following procedures:

(*a*) By reducing takings from oil producers resulting in disruption of field operations, waste of gas and discouraging conservation by the oil producer.

(*b*) Offering surplus gas to industrial users at rates competitive with fuel oil. Such surplus users are theoretically subject to discontinuance of service when gas is required for superior classes of service. But, in practice, surplus-gas marketing results in the production of much gas for classes of service which do not require fuel of such high quality, thereby wastefully using an irreplaceable natural resource.

(*c*) Supplementing the supply of casinghead gas in times of peak demand by production from dry gas fields or oil fields of high gas ratio or, in some cases, by withdrawal of gas from storage.

I shall endeavor to outline what we believe to be the evils of the present situation: Marketing of gas by the producer is dependent upon willingness of a gas company to provide transmission lines. Gas companies naturally desire to contract for a dependable supply; hence there is a tendency to favor large operators.

Casinghead plants are necessary intermediaries in gas marketing. The major producers have their own plants; for treatment of gas and for a share of the market. In times of excess gas production, some operators have no market.

The law of California forbids blowing of gas into the air. Oil cannot be produced without accompanying gas production. Therefore, ability to produce oil without violating the law is dependent upon possession of adequate gas contracts. A gas company contracts for required supply in Field A. Field B is later developed closer to the market, is accessible to pipe lines, but cannot procure a market due to adequate contracts in Field A.

Prices to producer are dependent upon his bargaining position and conditions existing at the time of contract. The larger number of contracts are for long terms, at prices dependent upon the base fuel-oil price. In many instances, conditions of taking do not offer inducement to the oil producer adequate to make the capital investments necessary to conserve gas for marketing. Therefore, much gas in wastefully used in the field.

"Rule of capture," the law applicable to oil production, hinders development of underground storage projects. Frequently, a lack of understanding by the landowner tends to prevent a cooperative gas-conservation project.

A considerable number of industrial plants which have become accustomed to a supply of cheap gas under surplus rates are demanding continuation and expansion of the so-called surplus service which, if encouraged, will tend towards inefficient utilization of our gas reserves. This development has become further complicated by plants engaged in defense activities.

There exist today two administrative agencies which possess regulatory authority over production and utilization of natural gas. The functions of each are distinct. To the state Department of Natural Resources have been given certain powers appropriate to conservation of gas at the source of production, while to the state Railroad Commission have been committed broad regulatory powers over certain of those enterprises which make beneficial use of gas prduced, that is, public utility gas companies.

A utility engaged in distribution of gas may also be engaged in production and transmission. By virtue of provisions of the constitution and the Public Utility Act, the Railroad Commission may regulate each of these parts of a utility gas service. But it must be remembered that most gas production today is not in public utility hands, and that gas production, standing alone, is not necessarily a public utility service. Therefore, authority exercised by the Railroad Commission, as the constitutional provisions are now construed, must be limited to regulation of businesses which legally are classifiable as public utilities.

In conclusion, may I say that we have been enjoying splendid cooperation from oil producers and gas utilities. I am hopeful that special studies being carried on by the commission will ultimately result in a program of sound regulation covering a wasting asset.

•

Good Engineering Practice And the Small Operator

ERNEST N. MERRILL
Consulting Engineer and Superintendent,
Guijarral Service Co.

A.I.M.E.—Abstracted from paper presented at southern California section, American Institute of Mining and Metallurgical Engineers, meeting, Los Angeles, Calif., October 29-30.

THE majority of California oil companies operate less than 100 wells each. The average number of wells per operator in this group is six, according to data published by the Division of Oil and Gas. With so few wells, the volume of engineering work done by the average company is so small that engineering services generally are obtained on a part-time basis or not at all. Part-time or temporary engineering services usually are performed either by a member of the organization dividing his time between engineering and operating or by a consultant.

When an experienced small operator considers acquiring nearby property, his past experiences with profits from his own wells generally are sufficient for him to evaluate the property for sale. However, when the property involves situations new to him, it may be useful to have an engineer's analysis covering conditions in the reservoir, possible development program, future oil recovery, operating conditions, and anticipated profits.

The employment of engineers during deep-drilling programs generally is taken for granted. Shallow wells often require equally important work, notably in mapping the structure, analysing reservoir conditions, determining well locations and completion depths.

An example of the coordination of drilling and production by small operators is found in recent development in the Kern River field. During drilling of several areas of this shallow field, central powers were installed after only a small percentage of the total number of wells were drilled. Each central power was designed for the ultimate number of wells in the area it covered and jack lines were provided for all wells to be drilled.

In determining the advisability of rehabilitating old producing properties, one of the problems frequently encountered is low return on money invested. Future production rates on old-

(Continued on Page 175)

Causes and Prevention of Drill-Pipe and Tool-Joint Troubles

(Continued from Page 164)

the dies holding the pipe may not be set tight enough, or are designed improperly, or the machine has not stopped soon enough, causing the grips to slip and gouge deeply into the pipe. The bottoms of such transverse marks can be ideal starting points for fatigue failures.

If not too deep, such scars can be removed by filing or by grinding, and the lengths reclaimed for service. The filing or grinding should be done with strokes which are practically longitudinal with the pipe. Transverse strokes, although apparently removing the grip marks, may leave fine scratches which could be just as effective starting points for failure as the original scars.

Slip marks (elevator or spider).—Inasmuch as drill pipe seldom is picked up with slip elevators, these comments apply almost entirely to the rotary-table spider slips. These, for many years, have been made with fine serrations, or knurling, which do not make injurious marks on the drill pipe.

Nevertheless, there are still in use a most surprising number of old-style slips which have V-section grooves and which make sharp-bottomed transverse marks. Needless to say, there is no excuse for such slips. Even with fine serrated slips, injurious transverse scars can be made. For example, drill pipe sometimes is rotated by the table slips, when going into or out of sticky formations, so as to make certain that the string is free, and in order to obviate the trouble of screwing on the grief stem. If the string turns a little hard, the pipe can slip enough to make transverse scars which could induce breakage. Such lengths should be discarded, or the scars filed out, as in the case of screwon-machine grip marks.

Also, when making up or breaking out drill-pipe stands, without backup tongs, the pipe may slip enough to make bad scars. Such scars are usually spiral, because the pipe is dropping while it is slipping. Backup tongs always should be used unless there is so much weight (of pipe in the hole) that it cannot possibly turn in the spider slips.

Overshot-slip marks also can make good stress-concentration points for fatigue breaks. Fortunately, however, these usually are so deep and so dangerous looking that the fished-over length is discarded immediately.

Rock-bit teeth scars.—Broken-off rock-bit teeth often float up with the cuttings, in the mud stream, and apparently get imbedded either in the wall of the hole or in the drilling string. Proof of this often can be found by a careful scanning of drill collars in areas where hard formations are being drilled. Many transverse scars and little triangular marks can be seen readily and, occasionally, a small piece of rock-bit tooth can be found imbedded in the drill collar. Laboratory study definitely establishes that the pieces really are broken-off bit teeth. Ordinarily the drill pipe, being of smaller diameter and being above the drill collars, is not scarred much by rock-bit teeth, but some few cases have been found—and very occasionally breaks have started—when the bit-tooth scar happened to be quite sharp-bottomed.

There is not much remedy for trouble such as this; but, naturally, the less the pipe is subjected to bending, the less likelihood there will be of the scar causing a failure.

Electric-flash marks.—While tool joints are being welded to drill pipe, in the field, they often are rolled on skids of discarded pipe. If the welder attaches his ground wire to one of the skids instead of to the joint he is welding, there can be an arc formed between the pipe and the

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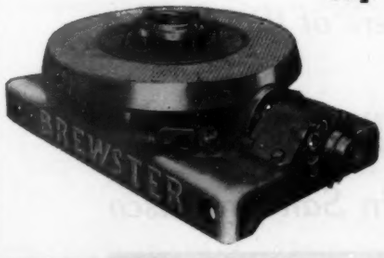

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skid, as it rolls along—leaving a circumferential arc scar. These scars have been known to act as the start of a fatigue break.

The remedy, obviously, is to see that the ground wire is clipped directly to the pipe, or tool joint, during welding.

Much worse than accidental flash marks would be to letter or number drill pipe with an electric arc, as often is done on other rotary equipment and occasionally on drill pipe. The edges of the arc-formed letters would be almost glass-hard and brittle, and probably would have minute cracks where the deposited metal cooled and cracked away from the pipe metal. Needless to say this would be almost sure to produce fatigue failures, even though such marking were done on the upset section of the pipe. Electric-needle marking actually has caused many failures in California.

Steel stenciling on drill pipe.—Inasmuch as any transverse mark can be a dangerous stress-concentration point, it is not surprising that steel stencil marks can be the start of fatigue cracks wherever any part of the letter is transverse to the pipe. This is well illustrated in the group in Fig. 7. The fractured piece is the crack started by the crossbar of the letter A. The mud-eroded crack had started in the horizontal line of the numeral 7.

If pipe must be steel-stenciled on the body of the pipe, special roman-numeral stencils can be made to order, thus IX, etc., with no transverse lines. And then extra care must be taken to see that these numbers always are stamped longitudinally. Also special stencils are made with a series of dots, instead of lines, which would not make dangerous transverse scars, thus . . .

Sharp fillets or upset runouts.—The abrupt change in section, from pipe o.d. to tool-joint o.d., as in any design where the pipe is upset to give an 18° elevator shoulder, is a point of stress concentration. Going back to the illustration of bending a nail in a vise, the tool joint acts as the vise and the pipe as the nail. Any effort to bend the nail concentrates the stress close to the vise, because everywhere else along the nail the bending stress distributes itself along some appreciable length.

The sharper the edges of the vise, the more the stress will be concentrated at the point where the nail is in contact with it, and the quicker the nail can be broken. A nail in an old, worn vise can take on some radius of bend, and cannot be broken very quickly.

Too sharp a radius is a manufacturing defect. The remedy is to design the upset in such a manner as to give the greatest possible radius, at the upset runout, consistent with proper handling with the elevators. Most manufacturers now solve this problem approximately as shown in the right-hand design of the two sketches in Fig. 8.

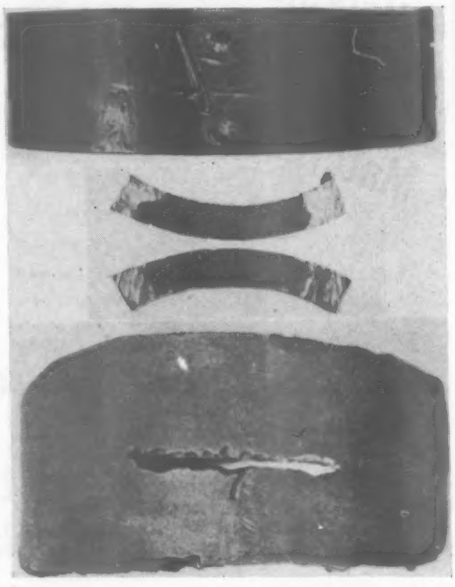

Fig. 7—Notch-fatigue failures from steel-stencil marks

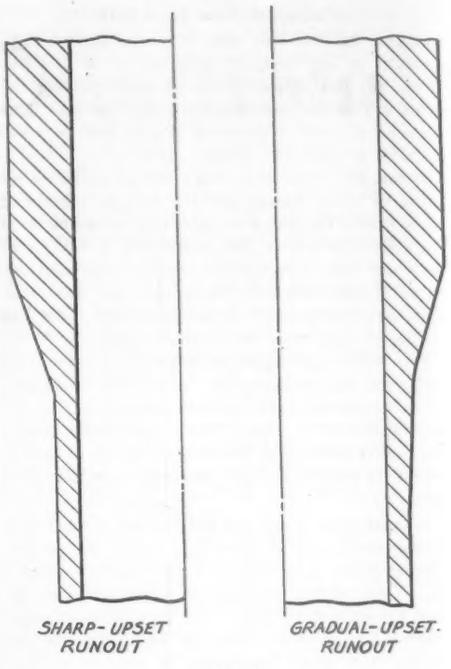

Fig. 8

Even at best, however, sufficiently high bending stresses eventually will break the drill pipe somewhere near the upset runout. If the pipe still fails from fatigue, in the right-hand design the break now will occur some inches away from the upset runout, and not too early in its life. Here, again, the less the bending imposed on the pipe, the longer its life will be.

Boring (or turning) tool marks.—Occasionally, in making heavy external upsets on drill pipe, as for 18° elevator shoulders, the inside is so rough after upsetting that a boring operation is necessary. Unless the boring is done with a round-nose tool, and especially if the boring extends on into the nonupset part of the pipe, the bottoms of the tool marks act as notches (stress-concentration points) and can lead to failures. . . .

Upsetter wrinkles.—In upsetting drill pipe, the ends are heated to a forging temperature and the metal of the wall is forced back on itself to thicken the walls the desired amount. The thickening may be entirely on the inside or the outside, or both.

If the operation is performed properly, the metal will flow plastically, and the dies will be filled almost as though the metal had been molten. But if the dies are shaped improperly, or if the temperature of the pipe is incorrect, the metal may fold on itself and form a wrinkle (or wrinkles). Wrinkles look like a series of cracks and, being circumferential, may act like cracks as the starting point of fatigue failures. Upsetter wrinkles may be found both on the outside and on the inside. They can be found, however, and inspectors are on the watch for them, particularly when heavy upsets are being made for 18° elevator-shoulder designs. When they do occur, inside wrinkles are almost always under the heavy section of the upset where bending stresses are lowest; and, therefore, seldom lead to failures. There are very few cases on record of such wrinkles ever having caused failures. The example illustrated had drilled some 75,000 ft. of hole with no sign of failure, and was found by an optical, internal-inspection device.

(To Be Continued)

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The Amount and Measurement of Internal Corrosion in Gasoline Pipe Lines

By J. M. PEARSON
Susquehanna Pipe Line Co.

A.P.I.—An extended abstract of a paper presented before the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7.

THE principal problems posed by internal corrosion are:

1. How to restore and maintain pumping capacity.
2. How the progress of corrosion affects the pipe wall.
3. How the corrosion process itself might be controlled.

Perhaps the first indication of the amount of internal corrosion in gasoline lines is to be found in the reports of difficulties with strainers or settling tanks. The rust did not arrive at a uniform rate, but rather in batches. Averaged over long periods the number of strainers full, or inches of sediment, was higher from those parts of the lines nearer originating tanks. Also, on the average, the hydraulic friction was worse near the origin of the lines. From the more remote parts of the lines the scale retrieved carried larger proportions of the lower oxide than did the scale from the line nearer the origin.

To determine the "amount" of corrosion inside a pipe the investigator has the traditional two choices. He may choose as the measure of corrosion either the depth of penetration, or the weight loss, or both. Except in the instance when the corrosion is general and the pits so small and numerous that they practically merge, there is no reliable relation between depth of penetration and weight loss. If the corrosion tends to localize and produce deep pits, the pit depth is the better criterion of the trouble to be expected. Internal corrosion of gasoline lines, however, occurs in a thin film of water as the result of oxygen diffusion. Because of this, the corrosion resembles atmospheric corrosion. The attack is generalized, and the pitting of the hard base metal at any time presents a relatively low profile.

Measurement of the internal corrosion by the use of test coupons requires the insertion of the coupons into the stream.

The coupon consists of a steel sample, carefully weighed, and provided with a hole at one end for mounting. By means of the hole, the coupon is fastened with a thread to the glass rod through which a lateral hole has been drilled. This rod is held in a steel socket at the end of a ¼-in. rod extending through the stuffing box. The shoulder on this socket prevents a possible blowout, and by means of the stuffing box the coupon can be raised out of the way of scrapers—or, using the valve, it can be removed entirely. Although the corrosion rate experienced by such test coupons corresponds roughly to the corrosion rate experienced by the pipe wall after sufficient elapsed time, I doubt that the relation is precise enough to permit extrapolation from so small an area. The chief difficulty in using coupons to measure this corrosion is that there is a time delay after immersion before corrosion begins in earnest. To follow the progress with time, many coupons are needed—because, having been cleaned for weighing, a coupon must pass through the initiating period before corrosion proceeds as before. From the results at hand it is evident to the writer that too few coupons have demonstrated only the range of their variation.

In view of the unknown effect of scraping on the rate of internal corrosion, and considering the possibility that unusual turbulence might affect the corrosion rate of the coupons, it is eminently desirable to measure the corrosion of the pipe wall directly.

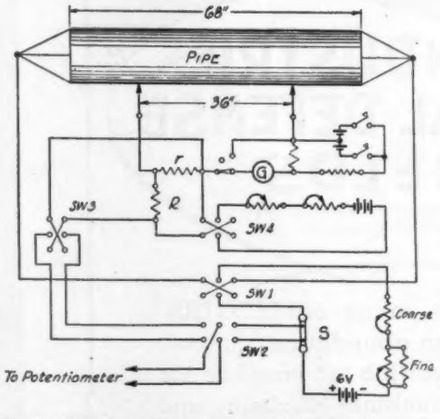

Fig. 1—Circuit used in measurement of internal corrosion

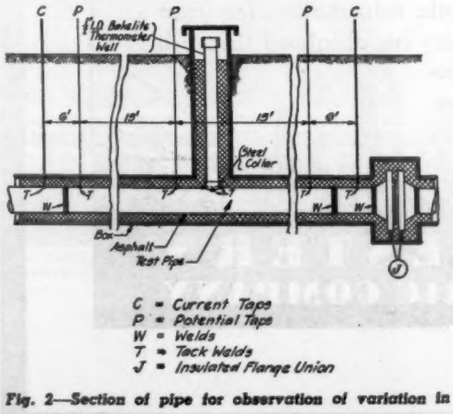

Fig. 2—Section of pipe for observation of variation in weight

Two types of experiments are in progress for the measurement of weight loss directly on the pipe wall. In the first experiment a joint of pipe was cut into four sections, each of which was sand-blasted clean. The ends of these sections were machined square and perpendicular to the bore. Careful measurements were made of each section, recording the length and the weight. These weights were reduced to pounds per foot of length. The sections then were welded into a trunk line. The outside of the line was protected by a box filled with asphalt to limit the corrosion to that occurring inside. The observations were scheduled to be made at the end of 2, 4, 8, and 16 years.

Upon the removal of the pipe sections for reweighing, the pipe again was machined square (though shorter). The weight of the section was determined by means of careful measurements of the pipe resistance. This method of determining the weight of the pipe depends upon the fact that the electrical conductance of a fixed length of a cylindrical conductor varies directly with its weight and inversely with its temperature.

Because of the shortness of the sections, the measurements were made by use of the circuit shown in Fig. 1. Referring to Fig. 1, the test current passing through precision shunt S and reversing switch $SW1$ is delivered to the ends of the pipe through bridles of four wires attached at evenly spaced points around the ends. These bridles serve to distribute the current as evenly as possible to the ends of the pipe. A distance of 3 ft. is measured off in the center of the pipe, leaving a distance of 16 in. at each end for uniform current distribution. The 3-ft. distance is marked off parallel to a generatrix of the cylinder. Four such short spans, in different quadrants, are used to afford a check. These distances must be measured to a precision of ± 0.036 in. to attain an accuracy of one-tenth of 1 per cent. The foregoing measurements were well within this limit. The potential measuring circuit consists of a Brookes deflection potentiometer with a precision adjustment of 0.04 per cent, connected to the switch $SW2$. This switch transfers the potentiometer from the current shunt S to the potential ratio network shown in the center of the drawing. When the current is reversed by means of switch $SW1$, it is necessary to reverse the leads of the potentiometer by means of $SW3$. The potential ratio network consists of two resistances R and r, through which a current is passed by means of a battery and rheostats and reversing switch $SW4$. The IR drop in the resistance r is used to return the reading of galvanometer G to zero in the presence of the IR drop due to the current passing through the section of the pipe under test. Included in this galvanometer circuit also are thermoelectric electrical motive forces and contact potentials of unknown value. It is because of the presence of these that it is necessary to reverse the current and potentiometer and to repeat the reading. Examination of this procedure by the reader will convince him that the sum of the potentials measured divided by the sum of the currents used will be the desired resistance, independent of the stray potentials of the circuit.

The two push switches and corresponding batteries shown beside the galvanometer are used to speed up the readings. The galvanometer used has a sensitivity of $2 \cdot 10^{-9}$ ampere per division. In the circuit as shown such an instrument is exceedingly overdamped, so that the two push switches referred to were used to introduce a small current to place the galvanometer at its zero, where it could be observed for any drift which would indicate an off-balanced condition.

As the potentiometer was connected across the two resistances R and r in series, the potential used to balance the IR drop on the pipe could be multiplied by any convenient ratio. A convenient ratio is one permitting the use of the same high range of the potentiometer for both current and potential readings. After the apparatus has been adjusted for convenient ranges on the potentiometer, this ratio is measured by passing a steady current through the two resistances in the series, and by measuring the corresponding IR drops with the precision potentiometer. This is preferable to using a wheatstone bridge.

In projecting this work to cover more of the pipe-line system, it is possible to simplify the measurements to a great extent. Fig. 2 shows how a section of pipe is prepared so that its variation in weight can be observed without interrupting operation of the line. Simplification in measurement is achieved, because it is possible to make measurements on a longer section of pipe. (For the purpose of obtaining a check, the longer section can be divided into two smaller ones which will show whether the corrosion has a perceptible lack of uniformity). The potential connections P at the ends and in the middle of the test pipe should be made by brazing the copper cable to steel lugs which can be tack-welded to the pipe in a manner which will heat the very minimum amount of pipe wall. The thermometer well can be attached in the same way. These connections, the entire joint of pipe, and the insulating joint are all included in a box which is poured full of asphalt. The purpose of the insulating joint is to eliminate stray currents which would interfere with the readings. The asphalt, besides protecting the outside of the line from corrosion, extends the insulation provided by the joint to include the entire electrical circuit.

Although the bottom of the thermometer well is made of metal tacked to the pipe, the extension above and beyond the asphalt box should be made of bakelite or similar material to avoid errors in the temperature readings due to heat conduction (thermocouple arrangements might be devised if desired.) When an installation of this sort is made, a sample (about a foot long) of the joint of pipe on which the electrical readings are to be made should be sawed off. This sample is used to measure the temperature coefficient of that particular pipe wall. If a reading is made of the pipe resistance and temperature at the time of installation, the conductivity, say at 15° C., can be used to represent 100 per cent of the weight of the pipe. As corrosion proceeds, it then becomes possible to determine directly what percentage of the pipe wall has been lost by repeating measurements of the pipe temperature and resistance. The resistance must be measured to the same precision with which it is desired to obtain the weight of the pipe, and the temperature measurement should be made with care in view of the fact that approximately 0.3 per cent error will be made for each degree Centigrade the reading is wrong.

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Conclusion

In conclusion, we should note that the present data are still too meager to permit really quantitative conclusions to be drawn. The outstanding results of the examination of the data on the amount of internal corrosion in gasoline lines can be summarized:

1. The rate of corrosion is higher in proportion to the amount of moisture and oxygen introduced into the pipe line.
2. The rate of corrosion is highest at the point where these elements enter the line, and drops rather sharply at the more remote points.
3. Depending upon pumping rates (1), and upon location (2), the weight-loss rates of corrosion vary from 0.1 to 2 per cent of the pipe wall per year.
4. There is some evidence that scrapers used to improve gasoline-line capacities increase the average rate of corrosion.
5. The data contain no reason for alarm in regard to the effect of internal corrosion on the life expectancy of gasoline lines. Soil corrosion and other external factors still deserve first consideration.

●

A Practical Evaluation of Cements for Oil Wells

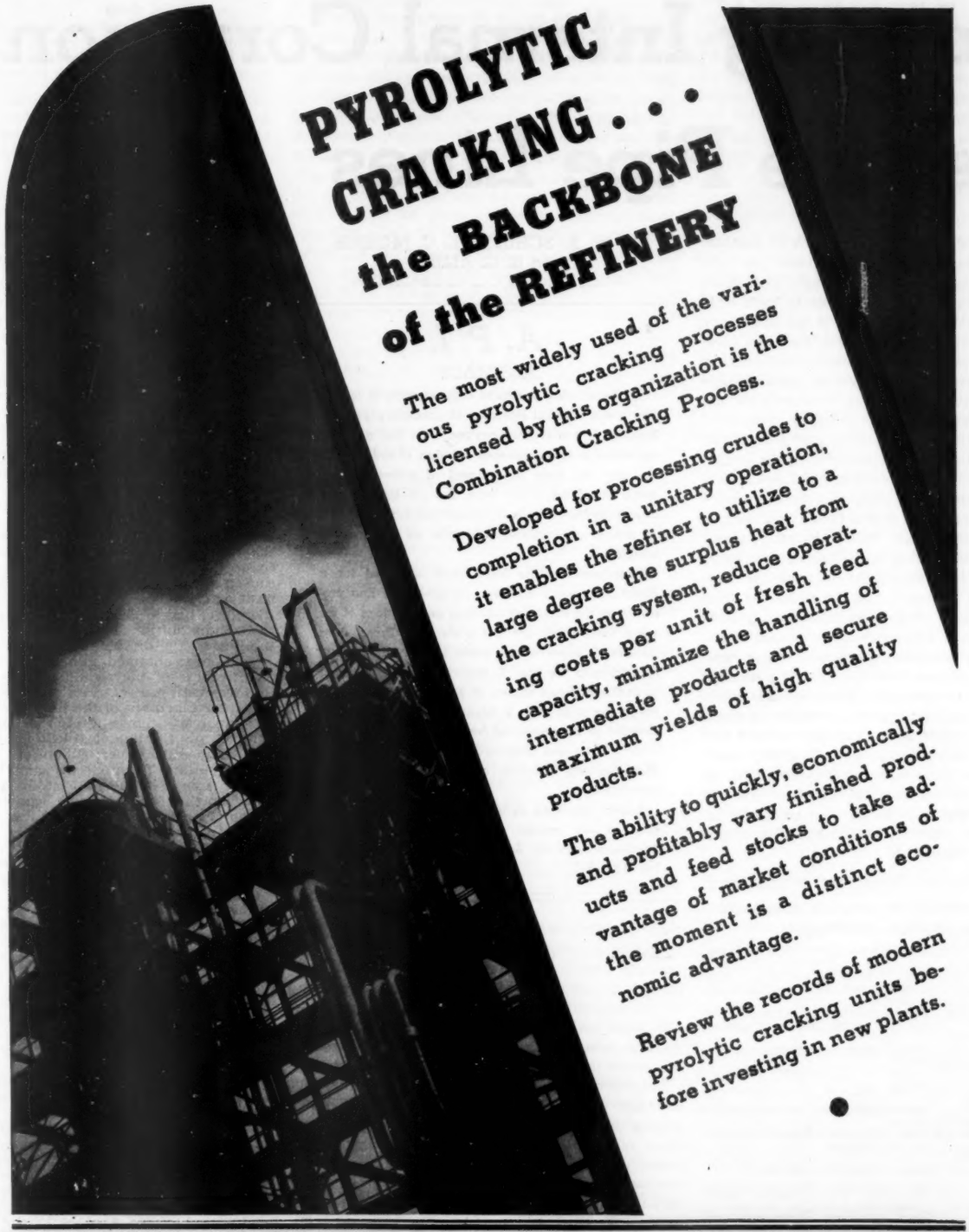
By R. FLOYD FARRIS (Stanolind Oil & Gas Co.)

THIS paper describes a special test procedure for evaluating cement slurries at temperature and pressure conditions which are reasonably close to those actually prevailing in the slurry during a cement job. Actual cementing conditions, as determined by extensive testing during cementing operations in various fields, are simulated in the pressure-type consistometer in

A.P.I. ABSTRACT

a manner which relates stirring time as a function of well depth.

The paper shows that high bottom-hole temperatures do not exist during normal cementing operations, that the effect of pressure on cement is considerable and actually overshadows the temperature effect, that it is possible to approximately duplicate actual cementing temperatures and pressures in the laboratory and obtain results which have a close relation to cement pumpability and that the results may be expressed in a form readily applicable to the problems of the field engineer. A depth-vs.-total-cementing-time chart is presented which will help guide the engineer in the selection and use of cements for any depth.



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Review of Methods Used in

Reducing Internal Corrosion of Gasoline Pipe Lines

By W. A. SCHULZE, L. C. MORRIS, and R. C. ALDEN
Phillips Petroleum Co., Bartlesville, Okla.

A. P. I. ABSTRACT

Methods being practiced commercially to reduce the rate of internal corrosion of gasoline pipe lines include: 1, removal of oxygen from the gasoline by injection of an aqueous solution of sodium sulfite into the line; 2, removal of entrained and some dissolved water from the oil by passage over dehydrated beds of commercial bauxite; and, 3, use of mercaptobenzothiazole as a corrosion inhibitor.

Experimental data have been obtained for a direct comparison between portions of a line protected by the corrosion inhibitor and sections of the same line which are not protected. These data include: 1, observations made on test bars placed in holders in the line; 2, amount of scale removed in sediment traps placed at each pumping station along the line; and, 3, inspection of adventitious samples of pipe removed from the line. The experimental data and observations obtained by these three entirely different methods show excellent correlation.

Paper presented before the Division of Production, at the annual meeting of the American Petroleum Institute, San Francisco, Calif., November 3-7, 1941.

UNTIL a few years ago shipment of gasoline by pipe line over great distances was relatively rare in the petroleum industry. The oldest line of any great length or size dates back little more than 10 years, while most of the lines have been in operation a much shorter time. In a recent article[1] W. M. W. Splawn mentions that there were approximately 9,500 miles of gasoline pipe lines in 1940, and that probably between 2,500 and 3,000 miles of additional line would be completed by the end of 1941. The conveying of gasoline by pipe line has followed improvements in the quality of the pipe, the use of protective measures in preventing corrosion of the pipe, and the experience of the earlier operators in this field. Because this activity is relatively new in the industry, many of the factors connected with internal corrosion during transmission of a light oil have not been investigated as thoroughly as those dealing with exterior corrosion. It is generally agreed, however, that the difficulties increase with age of the pipe line; therefore, we may expect to hear more about this subject as time goes in. The number of companies now operating gasoline lines totals almost 40, but only 13 have in operation as much as 200 miles of pipe. Several of the 13 have had their lines in operation such a relatively short period that very little information is available as yet on the conditions inside of the pipe. For this reason, the review of methods used to reduce internal corrosion s limited to the experience of a relatively few companies.

TABLE 1—EXPERIENCE OF PIPE-LINE COMPANIES WITH INTERNAL CORROSION

Company	Methods for Correcting Internal Corrosion
Standard Oil Co. (Indiana)	None — line in operation only short time. Scrapers used regularly.
Sinclair Refining Co.	None—line not yet in operation.
The Pure Oil Co.	Sodium sulfite for short period.
Socony-Vacuum Oil Co., Inc.	Dehydration of gasoline.
Tuscarora Oil Co., Ltd.	None.
General Petroleum Corp.	None.
Susquehanna Pipe Line Co.	None, except regular scraping.
Champlin Refining Co.	None.
Humble Pipe Line Co.	None, except occasional scrapers
Shell Oil Co., Inc.	No information.
Magnolia Pipe Line Co.	None—lines relatively new.
Great Lakes Pipe Line Co.	Reduction in entrained water and air. Tank strainers. Inorganic and organic inhibtors.
Phillips Petroleum Co.	Inhibitor in some sections.

Because of the great distances involved between refineries and sales outlets, the Mid-Continent section of the United States seems to have constructed more gasoline lines than other sections. The Great Lakes Pipe Line System and the Phillips lines comprise nearly one-third of the 1940 total.

It should be kept in mind also that data as to the condition of the inside of the pipe line are much more difficult to obtain than those pertaining to the exterior. Thus, an attempt has been made to collect information from those companies operating gasoline lines and the methods used by them to reduce the internal corrosion, with the thought in mind that this might be correlated with the various phases of the problem. The information obtained in this manner is presented herewith in summary form for the benefit of those interested in this problem of internal corrosion.

Inasmuch as it has been shown that internal corrosion is due primarily to a combination of factors in the gasoline stream—including suspensions of aqueous and solid treating materials, water, and oxygen—the problems which apply to one company may not necessarily apply to another because of the great differences in operating practices. For example, the pumping rate as well as the terrain will have a great effect on the amount of water and solids left in the line. In spite of these many variables, however, attention is directed to the available information on three methods for reducing corrosion, viz.: 1, removal of oxygen with sodium sulfite solution; 2, removal of water by dehydration of the gasoline; 3, use of an organic corrosion inhibitor dissolved in the gasoline.

Sodium Sulfite

Oxygen may be introduced into gasoline during the refining operations, tank storage, or by transfer pumps. Sometimes it is introduced not only at the inlet station of the pipe line, but at subsequent stations by air-controlled equipment. Complete elimination of air, of course, should reduce internal corrosion. D. E. Sullivan, of Pure Oil Co., has related the experience of his company with sodium sulfite as follows:

"The Detroit Southern Pipe Line is a 6-in. gasoline line 80 miles long, extending from Toledo to Hamtramck, Mich. It is operated continuously at from 615 bbl. to 635 bbl. per hour. For about a year we experimented with sodium sulfite(Na_2SO_3) as an interior corrosion inhibitor. We made up a solution consisting of 1 lb. of sodium sulfite to each gallon of water. This solution was then pumped into the line continuously at a rate that would amount to from 5 gal. to 15 gal. to each 24,000 bbl. of gasoline.

"When first we began pumping the solution into the suction side of the centrifugal pumps, we found that the centrifugal force inside the pumps caused the sodium sulfite to precipitate and deposit as crystals on the inside of the casings. We, therefore, had to change the arrangement so that the sodium sulfite solution would be pumped into the line on the discharge side of the pumps.

"We never obtained an accurate measure of the effectiveness of the sodium sulfite, but you will find herewith a copy of an analysis of samples of the water taken out of the line. You will note that this analysis shows that the sulfite solution pumped into the line at Toledo showed 347 grams of sodium sulfite per gallon of water and no sodium sulfate. Then on two samples of water removed from the line at Flat Rock, which is 40 miles north of Toledo, one sample showed 285 grams of sodium sulfite and 3.4 grams of sodium sulfate per gallon of water while the other one showed 177 grams of sodium sulfite and 19.4 grams of sodium sulfate. To me this indicates that we were getting some oxygen absorption into the sodium sulfite solution. However, whether this absorption actually resulted in an abatement of the interior corrosion, we cannot say definitely.

"This line is practically level throughout its entire length except for two or three places where it dips downward to the extent of about 30 ft. to 40 ft. at river crossings. I rather suspect that the sodium sulfite solution that we were injecting into the line progressed with the gasoline stream to these low points and collected there. We made a practice of running a rubber scraper once or twice each week, and then this scraper picked up the slug of sodium sulfite solution out of the low points and pushed it on to the scraper outlet. These low points in the line are very close to Toledo; and perhaps I am theorizing too much, but I think this was probably beneficial because it very likely forced contact between the sodium sulfite solution and the entire interior periphery of the pipe. I also believe that we could have made the sodium sulfite more effective if we could have entirely filled a space in the line between the scrapers with the solution and let this slug move through the entire length of the line, bringing about contact between all interior surfaces with the solution. We tried to do this, but unfortunately our arrangement of valves in the line is such that the process was impractical.

"After experimenting with sodium sulfite for about a year, we could not prove to ourselves that it was of material benefit, and we discontinued its use. We have never made use of any other inhibitors."

Mr. Keane, of Great Lakes Pipe Line Co., has reported the experience of his company with sodium sulfite as follows:

"Additions of the chemical in solid form were made to operating tanks over the system. Amounts

depend upon the quantity of water present, and sufficient chemical was added to remove the dissolved oxygen.

"Considerable difficulty was experienced in the additions of sodium sulfite to tanks during periods of drought when no water was present and in winter months when any water present was in the form of ice. This difficulty was overcome by installing small capacity pumps and injecting a saturated solution of sodium sulfite directly to the pipe line, the amount depending upon the volume of gasoline pumped.

"Immediately after the initial injections of sodium sulfite, a careful check was made monthly on the quantity of scale removed in the tank strainers at the booster station 25 miles downstream. The scale removed had been averaging around 75 lb. per month, and analyzed about 70 per cent iron oxide on a wet basis. The scale gradually diminished in quantity, until the amount was less than 10 lb. per month. For the ensuing year this quantity was substantially constant at the above figure, and remained so until the station was indefinitely shut down. At the same time, however, there was little improvement in the throughput capacity, line pressure, or C-value.

"The additions of sodium sulfite are being continued throughout the system. Although there is little tangible proof that the chemical is of much value, there is the possibility that conditions might get worse if additions cease."

Further reduction in the air content of the gasoline has been possible, according to Mr. Keane, through the development of a new type totally-enclosed alleviator, which excludes air from entering the line by way of the pumps. Reciprocating pumps with direct-contact air-loaded alleviators had been used prior to this development. The buffer liquid is ethylene glycol, a substance which will not freeze at any temperature to which it is subjected by the gasoline.

Dehydration of Gasoline

In 1936 the White Eagle Division of Socony-Vacuum Oil Co., Inc., placed a 6-in. line in operation between Augusta, Kans., and Kansas City. It was thought that oxidation of the pipe in the presence of water could be reduced or eliminated by satisfactory removal of the water at the primary station located at Augusta. Activated alumina was used as an adsorbent until 1939, when it was replaced by florite, a commercial bauxite.

The following statements regarding operation of this dehydration are quoted from a letter by Harry K. Phipps, of the engineering department:

"In practice, a battery of 4 drums, which are 4 ft. in diameter and 9 ft. high, are each charged with approximately 2,000 lb. of florite. The station piping is so manifolded that the incoming stream, at an average rate of 450 bbl. per hour (42-gal.), is split and pumped downward through 2 dehydrators in parallel.

"Rejuvenation or reactivation of the spent florite is accomplished in approximately 4 hours by introducing superheated steam into the dehydrator drum at a temperature of 400 deg. F., and then applying a vacuum to the drum for 1½ hours, after which the drum is purged with dry natural gas before being replaced in service.

"Of the products pumped, viz., Mobilgas Special, Mobilgas, Leaded Metro, White Metro, power fuel special, power fuel No. 1, kerosene, heating fuel No. 1, heating fuel No. 2, diesel and vapor-recovery gasoline, a reduction of moisture content of 40 to 50 per cent is effected. Moisture determinations are made periodically on the suction and discharge streams, by the use of iodine and sulfur dioxide in a dry solution of methanol and pyridine, which has been found satisfactory for determining small amounts of moisture in light oils. This method is assurate to 4 p.p.m., with due care being exercised in handling the sample.

"There is little question as to the material benefits which have been derived from the dehydration of gasoline and light petroleum products insofar as the operation of this 178-mile line is concerned. Numerous examinations of the interior of the 6-in. line, particularly in the vicinity of the primary station and at the intermediate station, which would logically show greater corrosive action due to increased pressure, have shown no evidence of corrosive action or attack."

According the Mr. Phipps, the original flow factor has been maintained consistently. Also, in practice it has been found that products should contain a minimum of moisture, when they are passed through the dehydrator drums, to reduce the rejuvenating process to a minimum.

Although not mentioned in this report, the chief disadvantage in moisture control would seem to be the necessity for introducing water slugs into the line during maintenance and while making changes, or by accidental introduction of water into the line. These changes in the lines tend to increase in number with age of the line, and are not so evident during the first few years of operation. Also the terrain may play a big part, in that the amount of water remaining in a line in a hilly country may be quite appreciable, and years of operation might be required to remove such water by its low solubility in partly dehydrated gasoline.

In order to prevent mechanically entrained water from entering the pipe lines, Great Lakes Pipe Line Co. requires that the water level in all operating tanks be held at a minimum. Some tanks have been equipped with a box dam under the suction-line intake, so that it is impossible for the tank to be pumped below a certain level. Water is held below this figure. Phillips Pipe Line Co. likewise makes every effort to keep out entrained water.

Corrosion Inhibitor

The prevention of internal corrosion of pipe lines by organic corrosion inhibitors in the gasoline was discussed in considerable detail two years ago.[3] It was stated that the inhibitor, mercaptobenzothiazole, was being introduced into the Phillips pipe line at two stations for the purpose of obtaining experimental information on the effectiveness of the inhibitor, and considerable discussion pertained to the various factors which accelerate internal pitting and rusting. It is proposed at this time to relate the experiences with this inhibitor during the past two years.

Inasmuch as the primary consideration of any operating line is to keep it running all the time at full capacity, there is usually very little opportunity to see inside the line—such an opportunity coming only during reconditioning or during line breaks. Samples of the pipe always are sent to the Phillips engineering department for complete inspection, whenever pipe is removed from the line for any reason whatever. Some information has been obtained in this manner; but, as the number of samples is small, it has been impossible to draw conclusions from these data except in connection with those obtained through the indirect methods mentioned hereinafter.

As a means for observing the state of the line, test bars weighing approximately 500 grams and prepared from steel of the same composition as the pipe have been supported in a vertical position inside the line at pumping stations or river crossings. These bars are pointed into the gasoline stream in such manner as to streamline the flow and prevent the occurrence of unusual conditions. By removing these test devices from time to time, it has been possible to obtain considerable information relative to the conditions within the line. In most instances a bar has been located so that it may be taken out for observation while the pumping station merely is bypased. In this manner the penalty for loss in pumping time has been reduced to a minimum. This means of indirect observation has been followed since 1936.

Mercaptobenzothiazole inhibitor has been added continuously at Borger, the inlet station to the Phillips line, and at Laverne, a station 110 miles from Borger, except for certain periods when it was desired to check results without inhibitor. Test bars are on the suction and discharge side of each of the three stations Stinnett, Spearman, and Darrouzett between Borger and Laverne. Early in this investigation the bars were removed from the line after about 6 months' residence. Several such sets were obtained, and in each instance it was noted that the amount of rusting gradually increased with the distance from the inhibitor station. Inasmuch as the inhibitor is used up when it reacts with the corrosion-producing substances, the concentration of the inhibitor decreases with distance from the feeding station. As it is well recognized that normally corrosion is greatest at the inlet end of the line and decreases with distance from the inlet, the test bars in the absence of this inhibitor would indicate this condition. As stated previously, exactly the reverse is true when inhibitor is added, thereby showing the beneficial effects of the inhibitor.

TABLE 2—OBSERVATIONS ON TEST SPECIMENS LOCATED FROM BORGER TO LAVERNE—BARS INSTALLED NOVEMBER 1938; REMOVED APRIL 1941

Location	Distance from Inhibitor Station No. 1	Comments
Stinnett	14 miles	Very little rust—bar in essentially as good condition as when put in line.
Spearman	42 miles	Same as Stinnett bar.
Darrouzett	75 miles	About half of bar covered by a loose rust coating; remainder bright as when put in line. Surface not attacked.
Laverne intake	110 miles	Surface covered by light coat of tightly adhering rust. No appreciable attack on bar.

TABLE 3—OBSERVATIONS ON TEST SPECIMENS EAST OF LAVERNE—BARS INSTALLED NOVEMBER 1938; REMOVED APRIL 1941

Location	Distance from Inhibitor Station No. 2	Comments
Beaver River	3 miles	Bar in perfect condition. No rust or corrosion products.
Buffalo	32 miles	Bar slightly roughened, but no appreciable amount of corrosion products present.
Cimarron River	34 miles	Bar in excellent condition. No rust or corrosion products.
Medicine Lodge	84 miles	No appreciable amount of corrosion products. Surface of bar not attacked.
Attica station	104 miles	Small amount of black corrosion products on bar. Surface underneath roughened slightly. General condition greatly superior to bars located here before inhibitor was added at Laverne station.

Following installation of the inhibitor station at Laverne, practically an exact duplication of the aforementioned results was obtained—the specimens showing least corrosion where the concentration of inhibitor was highest, and a greater amount as the concentration decreased.

In November 1938 it was decided to leave test speciments in the line over a long period to note the effects of the inhibitor on older pipe, an experiment designed to approach a surface condition similar to that of the line itself. Many of these bars were examined regularly, sometimes as often as once a month, and were never out of the gasoline stream more than a few minutes at a time. In April 1941, after having been in the line almost 2½ years, some of these test specimens were removed. The final set of observations on these bars is given in Tables 2 and 3.

The experimental data in Tables 2 and 3 indicate that the inhibitor prevented corrosion in the section of line from Borger to Attica station or possibly beyond.

For a direct comparison with a section of the

line not protected by inhibitor, data are given in Table 4 on bars removed from several stations east of Paola, a distance of 450 to 680 miles from Borger. Under normal operating conditions the concentration of oxygen is much lower in the gasoline throughout this section, so that it should show less corrosion than the section near Borger if both were operated without the inhibitor. These bars, however, indicated rather severe corrosion.

Due to the limited number of specimens in the line, and to the fact that it was desired to keep some of them in the line for even longer periods, all of the desired data could not be obtained. It was possible, however, to get an idea of the weight losses on a representative number of the bars noted in the foregoing tables. The bars were brushed carefully before weighing, but were given no other treatment. The weight losses are shown in Table 5, and amount to as much as 2.5 per cent per year in some of the uninhibited sections.

TABLE 4—OBSERVATIONS ON TEST SPECIMENS IN UNINHIBITED LINE—BARS REMOVED APRIL 1941

Location	Bar Installed	Comments
Leeton (mile post 489)	October 1940	Bar covered by a heavy layer of corrosion products. Surface of bar attacked under this black layer.
Villa Ridge (mile post 639)	February 1939	Bar covered by a very heavy deposit of black corrosion products. Surface of bar being attacked under deposit.
Meramec River (mile post 671)	March 1939	Bar covered by heavy black deposit. Surface rough under this layer.
Mississippi River (mile post 671)	March 1939	Bar covered by a very heavy layer of black corrosion products.

Another means for determining the rate of corrosion is available on the Phillips line, in that sediment traps are placed on the intake side of each station. The rust and scale settles out of the gasoline, and it is withdrawn periodically by the operators who report the quantity in cubic feet. During the first 6 months of 1941 very careful records were kept, and the data are presented in Table 6.

TABLE 5—LOSSES IN WEIGHT OF TEST SPECIMENS IN GASOLINE LINE—APPROXIMATELY TWO YEARS

	Per Cent Loss in Weight	Per Cent Loss in Weight Per Year
Laverne intake (near end of first inhibited section)	0	0.
Cicammon River (33 miles in second		
Leeton (not inhibited)(mile post 489)	3	2
Villa Ridge (not inhibited) (mile post 639)	4	2
Meramec River (not inhibited (mile post 671)	5	2.5
Meramec River (not inhibited) (mile post 675)	5	2.5
Mississippi River (not inhibited)(mile post 680)	4	2

TABLE 6—SCALE REMOVED IN SEDIMENT TRAPS AT PIPE-LINE STATIONS

Location	Total Cubic Feet of Scale Removed in 6 Months	Average Cubic Feet of Scale Removed per Mile	Average Number of Scrapers Used per Mile per 6 Months
Borger to Laverne (first inhibited section) 110 miles	60	0.55	0.56
Laverne to Attica (second inhibited section) 104 miles	23	0.22	0.08
Harrisonville to Leeton (uninhibited, mile posts 449-488)	130	3.33	0.73
Leeton to Syracuse (uninhibited, mile posts 488-526)	192	5.05	1.13
Syracuse to Jefferson City (uninhibited, mile posts 526-565)	208	5.33	1.31
Jefferson City to Rosebud (uninhibited, mile posts 565-602)	409	13.24	0.68
Rosebud to Villa Ridge (uninhibited, mile posts 449-488)	130	3.33	0.73

It should be noted that in 214 miles of inhibited line the total sediment collected in 6 months amounted to only 83 cu. ft. On the other hand, a particularly bad uninhibited section of 189 miles gave a total of 1,453 cu. ft. of scale. This difference in magnitude is so large that one wonders whether certain other factors may have contributed somewhat. For example, there are differences in flow rate and scraper programs in the two portions of the line. However, if the 1,453 cu. ft. of scale is converted into pounds and divided by the total weight of pipe, the figure is slightly more than 1 per cent for the 6-months' period. As noted in Table 5, the weight loss of the test specimens in this section averaged slightly more than 2 per cent per year. Thus, two entirely different means of determining the extent of internal corrosion give exactly the same results. The same may be said for the inhibited section, where the bars show no weight loss and where no appreciable scale is removed.

Samples of pipe from the line tend to confirm the results noted previously. Depths of pits can be measured; but, as operating conditions have been changed many times since the line first was put into operation, it is difficult to say when these were formed. Likewise the scale in sections of pipe through which scrapers have never been run is greatest in those pipe specimens removed from the uninhibited line sections mentioned previously. The heaviest deposit noted on any sample of pipe amounted to slightly more than 1 lb. per foot length of the pipe. Another section of pipe from this same area showed approximately 0.6 lb. of scale per foot of pipe. Those sections through which scrapers are being run generally show very little deposit on the walls. It may be mentioned that not a single piece of pipe from the inhibited sections of the line has shown any appreciable scale. This ties in with the other data, although the number of pipe samples has been too small to make statistical correlations on this basis alone.

On the basis of the results presented in the foregoing tables, a third inhibitor station is to be installed soon at Paola, the beginning of the section where so much scale is being removed.

In the paper presented two years ago on mercaptobenzothiazole as a corrosion inhibitor, it was stated that this compound, containing a mercapto group, is oxidized to the disulfide form. Because of this reaction, the life period of the inhibitor varies considerably from one gasoline to another. Thus, it is really hard to say just what length of line one inhibitor station may protect. This is especially true when the line handles many different products, each of which shows a different effect on the inhibitor. It has been suggested also that intermittent injection may produce the desired effect, but the answers to all of these problems will require much diligence.

The excellent correlation between the data obtained by means of test specimens and the amount of scale from the settlers, as well as the observations on the available pipe samples, lends considerable credence to the belief that the corrosion inhibitor has benefited materially the operations on the Phillips line.

The Great Lakes Pipe Line Co. has tested mercaptobenzothiazole inhibitor in a 50-mile line section of 6-in. pipe. Mr. Keane states that "prior to introduction of Rokon (mercaptobenzothiazole) a total of 35 scrapers was run, and the C-value of the line restored to approximately 142—the value for new pipe of this size. Sufficient Rokon then was added, in the form of a slurry in light mineral oil, so that a measurable trace was detectable at the downstream station 50 miles east. After 9 months' use of this chemical, it is obvious that the necessity for running scrapers has subsided to some extent, and the capacity of the line remains at a higher figure than formerly. To be exact, the line capacity has been approximately 12 per cent greater than formerly. At the same time the high cost of Rokon, together with injection expense, does not justify the use of the chemical for results obtained."

The value of corrosion inhibition involves many intangible factors, and does not depend altogether on the method used to obtain the inhibition. For example, the capacity of the line may be kept up in part, even when corrosion is substantial, if sufficient scraping is done. An increase in scraping, however, increases general operating costs. Also, as the amount of scale increases, the station operating costs rise due to chewing up pump packings, etc. Likewise, the effect of iron-oxide scale in a gasoline in turbulent motion in the presence of oxygen is to decrease the gum stability of the gasoline. Thus, any loss in gum stability due to increased internal corrosion of the pipe will have to be overcome, insofar as possible, by the addition of more gum inhibitor. These factors,

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as well as the structural strength of the pipe, must be considered when any evaluation of corrosion inhibition is made.

A comprehensive cost study is most difficult because of these many intangibles (which in many instances amount to very large figures), but an attempt has been made to show the value of corrosion inhibition in terms of life of the pipe. In these figures the intangible values, such as increased pipe capacity, difficulties arising from iron-oxide scale, increased scraping, etc., have been left out; the inhibitor cost is based upon the original pipe-line investment. Table 7 shows how much one can afford to spend for prevention of internal corrosion when the value of the pipe only is taken into consideration.

TABLE 7—MONEY AVAILABLE PER 100 MILES FOR CORROSION PREVENTION—BASED ON UNIFORM DESTRUCTION OF PIPE
(Intangible values omitted)

Installed value of pipe per ft.	Average per cent corrosion per year			
	0.5	1.0	2.0	3.0
$1.00	$2,640	$5,280	$10,560	$21,120
2.00	5,280	10,560	21,120	42,240
3.00	7,920	15,840	31,680	63,360

Table 7 shows merely that damage to the pipe itself is equivalent to $5,280 per mile, times the cost in dollars per foot of pipe, times the average per cent corrosion per year. Obviously, the figures are ultraconservative, because all experienced pipe-line men know that corrosion is not uniform. This means that the costs attendant to leaks, manitenance of the line, scraping, etc., plus the effects on product quality, should be added to the foregoing figures to give a true picture of the value of corrosion inhibition.

Acknowledgment

The authors wish to acknowledge their sincere appreciation for the information furnished through contact with the following pipe-line companies prior to October 8: Champlin Refining Co.; General Petroleum Corp.; Great Lakes Pipe Line Co.; Humble Pipe Line Co.; Magnolia Pipe Line Co.; Shell Oil Co., Inc.; Sinclair Refining Co.; Socony-Vacuum Oil Co., Inc.; Standard Oil Co. (Indiana); Susquehanna Pipe Line Co.; Pure Oil Co., and Tuscarora Oil Co., Ltd.

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Good Engineering Practice And the Small Operator

(Continued from Page 166)

er properties are comparatively well known, so by careful figuring, this type of production is handled on a business-like basis

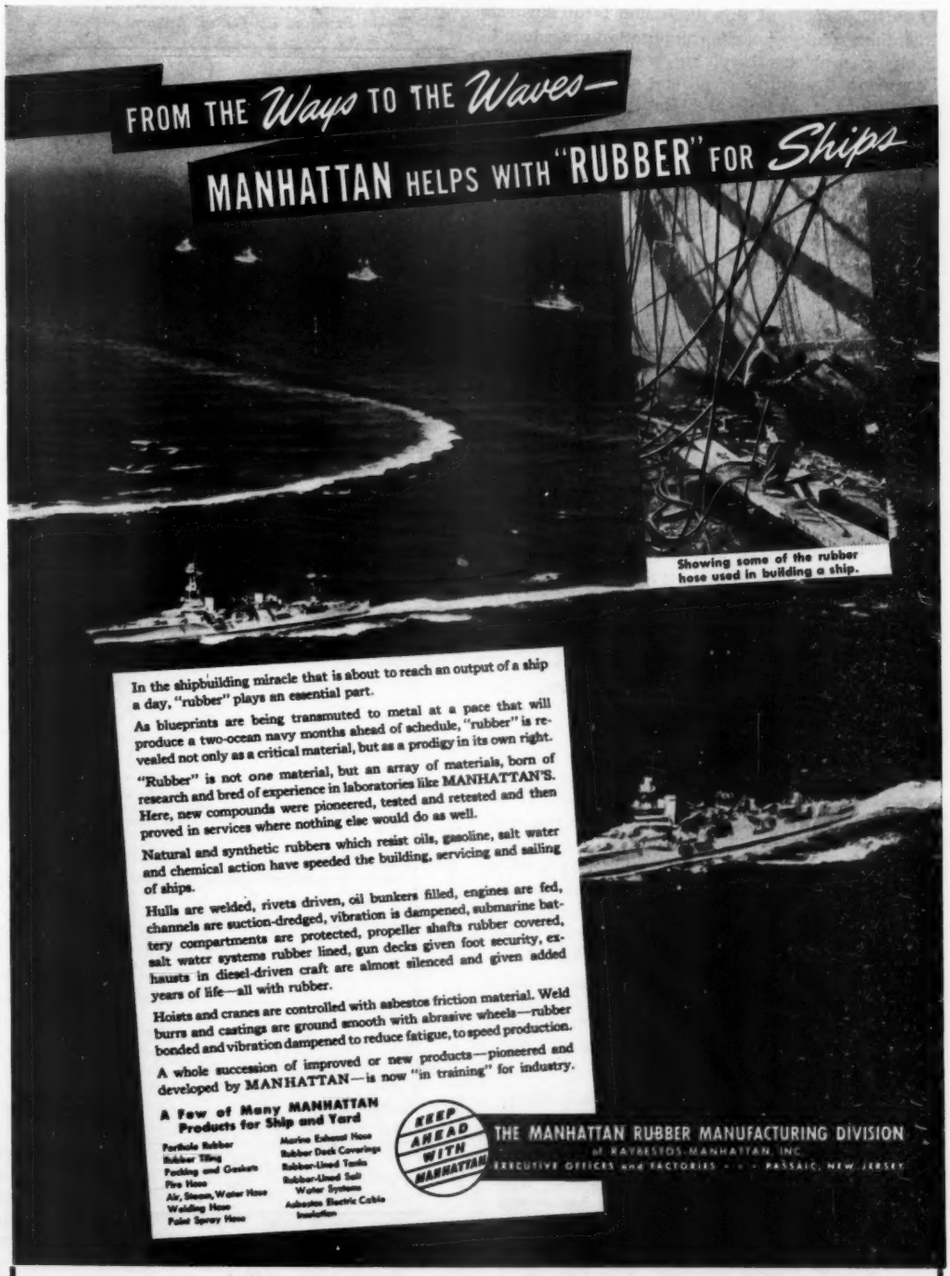
The author had an experience in comparing the merits of a proposed central power with individual pumping units that involved an unusual angle. In this case, the property was acquired with five wells capable of production but with no equipment other than casing and derricks. It was estimated that the first cost of the units would be greater than the complete central-power and jack-line system but could be installed much more rapidly. The greater amount of oil that could be recovered by the pumping units during the first month or two of service, as a result of earlier installation, was sufficient in itself to make the units more attractive.

The most important work an engineer can do is to assist in pianning for the future, especially where well repairs and drilling are contemplated. Some companies which do not compensate for production decline by drilling appear to have contradictory evidence for the desirability of spending much effort in determining an operating program. Such companies obviously are going out of business gradually, and would appear to have little to plan for in the future. However, the declining production rate means increased lifting costs, so a program which considers this factor is necessary to maintain maximum profits.

The bases of most engineering assistance to the small operator are records made during drilling. If these records are maintained during routine operations, the small operator will find that upon the retention of a consultant he will receive more for his money. A competent engineer can advise an operator as to the kind of information he should obtain and how this information should be recorded.

The average small operator has a practically complete record of his operations if he keeps cost accounts, equipment inventories, repair data, and well-pulling records in addition to the data required by the Division of Oil and Gas on drilling, production, redrilling and abandonment. It is the author's opinion that the operator's interpretations of subsurface conditions also should be recorded. These records are most convenient in the forms of maps and sections and a brief report.

If a producer has wells that were drilled in the days when records were written with "pen and whiskey," it is discouraging to attempt a study of subsurface conditions. However, an interpretation of subsurface conditions based on these records and the operator's experiences often can be made serviceable as a guide in starting the drilling of new wells and in repairing old producers.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Practical Application of Equilibrium Relations to Oil and Gas Separation Problems

By J. E. LAURANCE
Standard Oil Co. of California

C.N.G.A.—Extended digest of paper presented at the sixteenth annual fall meeting of the California Natural Gasoline Association, Los Angeles, Calif., October 31, 1941

THE purpose of this discussion is to illustrate the usefulness of the computation procedure in solving problems involving separation of multicomponent mixtures of oil and gas under various conditions of pressure and temperature. Of recent years, multistage separation of well effluents has become an important factor in production practice, and a knowledge of results obtainable is essential to the engineer in both natural-gasoline plant operation and oil production. In most cases a theoretical analysis will suffice and it is only necessary to obtain enough experimental data to (1) serve as a basis for the theoretical analysis, and (2) make occasional checks on the theoretical results to ascertain that they are reasonably accurate.

Recent investigators of the phase behavior of various types of naturally occurring hydrocarbon systems have provided the industry with vaporization equilibrium constants for individual components which may be used in a large variety of computation procedures. In the low-pressure range deviation from the ideal gas laws is only slight, and engineering predictions can be made with a relatively high degree of accuracy. In the high-pressure range above, say, 500 lb. per sq. in., the deviations become greater, and as the critical region for the mixture is approached the deviation is often quite large. Although there is yet much to be learned concerning the phase behavior of mixtures in the extreme high-pressure range, investigators have already paved the way for estimating equilibrium constants in such a manner that valuable predictions can be derived. The engineer is not only enabled to study stage separation of the total well effluent, but is also able to predict volumes, temperatures or pressures, and even phases existing in the formation itself. These theoretical data employed in conjunction with a few substantiating pressure cell tests are therefore opening up a new horizon in the technology of petroleum production. The computations themselves are usually not as difficult as we have been led to believe by the appearance of lengthy mathematical analyses. This paper will discuss only a few typical examples where the computation procedure has been advantageous in solving problems concerning oil and gas systems.

Multistage Separation

In order to retain more of the desirable fractions in the oil and at the same time remove a greater amount of the undesirable gaseous fractions, an attempt was made to obtain better separation by approaching a differential vaporization process by progressively lowering the pressure in two, three or four steps. The well effluent is flashed and the vapors are progressively removed in one, two or even three separators before the oil is finally delivered to the tanks at atmospheric pressure.

With the advent of the natural-gasoline industry and the demand for sales gas deliveries at high pressures, stage separation also became advantageous as a means of conserving energy, and it is seldom that trap operating pressures are established without considering the optimum compression ratios for handling the various gas streams entering the plant. The optimum combination of trap conditions will vary with the pressures involved, the gas-oil ratio, the composition of the materials, the distribution of components desired, and an economic balance. Each general case must therefore be handled separately.

Gas Volume

Fig. 1 illustrates the effect of secondary trap pressure on the volume of gases evolved in a low gas-oil ratio system involving two traps operated in series followed by atmospheric tanks. Conditions are shown with the primary trap operated at both 500 and 300 lb. per sq. in for comparison. It will be observed that although individual gas volumes change rapidly as the pressure is altered, the total gas volume or the sum of the three individual gas volumes does not change appreciably. In general, when primary traps are operated in the range of pressures considered, the total gas volume is smallest when the secondary trap is operated at about 50 to 75 lb. per sq. in. This type of chart is of greatest use in estimating the volumes of individual gases that will be delivered to the natural-gasoline plant, the type of field collecting system involved, and the horsepower required for compression.

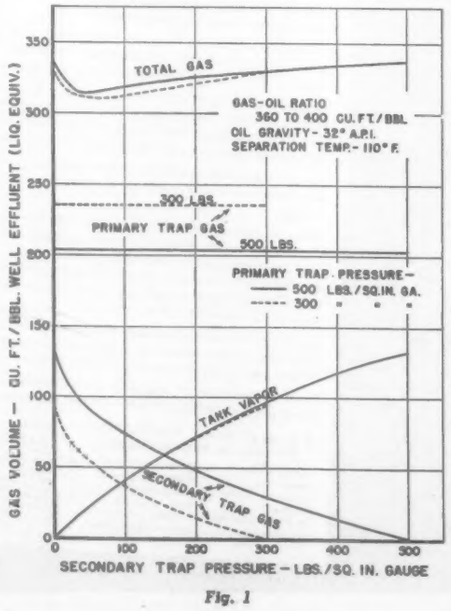

Fig. 1

Gas Enrichment

Fig. 2 illustrates the change in pentanes(+) enrichment of individual gases for the same conditions shown on Fig. 1. The volume and enrichment of the primary trap gas is of course not affected by the secondary trap pressure. Also, it will be observed that the enrichment in terms of gallons per 1,000 cu. ft. is not appreciably different for 500 and 300 lb. per sq. in. primary trap gas. Of particular interest is the fact that although the secondary trap gas enrichment changes considerably as the secondary trap pressure is altered, such changes do not affect the pentanes(+) enrichment of the tank vapors to any great extent. It will be remembered that although the enrichment of tank vapors is high, conditions are usually set to give a low volume of tank vapors in comparison with the other gases.

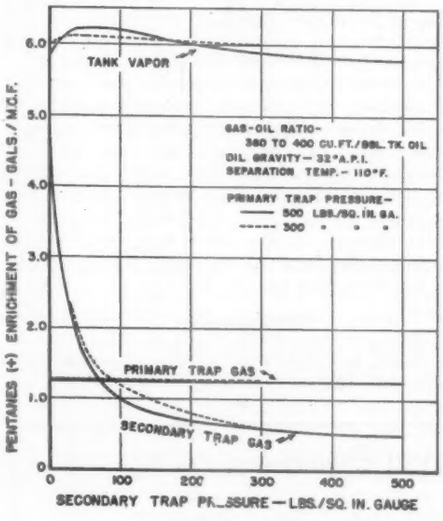

Fig. 2

Gasoline Content of Gases

Of more interest than the enrichment of individual gases is the actual amount of butanes or pentanes(+) fractions carried by the gases as shown on Fig. 3. These data are obtained by multiplying the gas volumes by the gas enrichments to obtain the actual content. Fig. 3 indicates that,

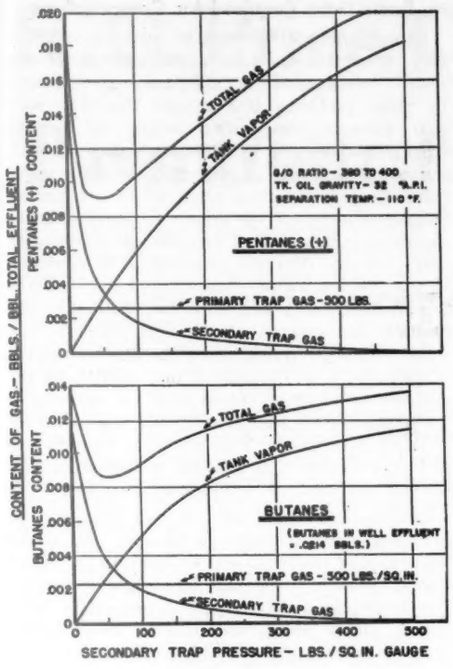
CONTENT OF GAS – BBLS./BBL. TOTAL EFFLUENT
PENTANES (+) CONTENT
TOTAL GAS
TANK VAPOR
G/O RATIO – 380 TO 400
TK. OIL GRAVITY – 32 °A.P.I.
SEPARATION TEMP. – 110 °F.
PENTANES (+)
PRIMARY TRAP GAS – 500 LBS.
SECONDARY TRAP GAS
BUTANES CONTENT
TOTAL GAS
TANK VAPOR
BUTANES
(BUTANES IN WELL EFFLUENT = .0214 BBLS.)
PRIMARY TRAP GAS – 500 LBS./SQ. IN.
SECONDARY TRAP GAS
SECONDARY TRAP PRESSURE – LBS./SQ. IN. GAUGE

Fig. 3

for the particular case considered with a 500-lb. per sq. in. primary trap, the minimum content of the total gas with respect to both butanes and pentanes(+) fractions is obtained when the secondary trap is operated at a pressure of 40 to 60 lb. per sq. in. It is also indicated that the tank vapors will contain from 50 to 80 per cent of the butanes or pentanes(+) fractions in the total gas if the secondary trap is operated at pressures above 100 lb. per sq. in. Where tank vapors are not collected efficiently it is therefore advantageous to operate the secondary trap at a low pressure.

Single-Stage vs. Two-Stage Traps

Where well pressures are adequate, it has become common practice to operate primary traps at 400 to 500 lb. per sq. in. in order that the dry gas may be delivered directly into high-pressure sales gas lines without additional compression. However, there are many cases where well pressure is not adequate or where the sales gas is not disposed of at high pressure. In such instances it is advantageous to compare results obtained at various primary trap operating pressures as illustrated in Fig. 4. An installation with only one trap ahead of the tank is represented by the solid-line curve. For this type of installation the minimum amount of pentanes and heavier fractions is contained in the gas if the trap is operated at about 100 lb. per sq. in. However, the content of the total gas can be further decreased by as much as 30 per cent by installing two-stage traps ahead of the tank. In a two-stage trap system the optimum combination of traps for this particular well mixture is 250-lb. per sq. in. primary trap operated in conjunction with a 40 to 50-lb. per sq. in. secondary trap.

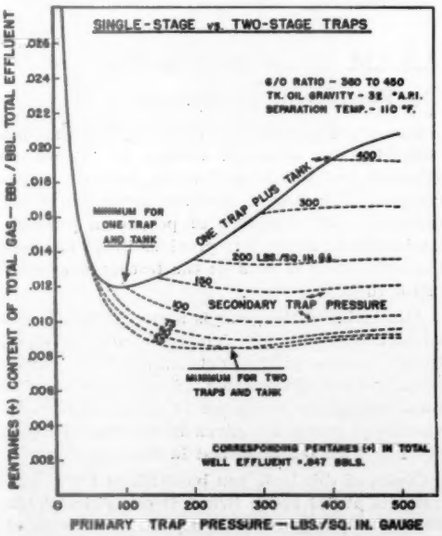
SINGLE-STAGE vs. TWO-STAGE TRAPS
G/O RATIO – 380 TO 450
TK. OIL GRAVITY – 32 °A.P.I.
SEPARATION TEMP. – 110 °F.
PENTANES (+) CONTENT OF TOTAL GAS – BBL./BBL. TOTAL EFFLUENT
MINIMUM FOR ONE TRAP AND TANK
ONE TRAP PLUS TANK
500
300
200 LBS./SQ. IN. GA.
100
50
SECONDARY TRAP PRESSURE
MINIMUM FOR TWO TRAPS AND TANK
CORRESPONDING PENTANES (+) IN TOTAL WELL EFFLUENT = .047 BBLS.
PRIMARY TRAP PRESSURE – LBS./SQ. IN. GAUGE

Fig. 4

The bubble point of the well effluent mixture employed as the basis for computed data shown in Fig. 4 was about 2,000 lb. per sq. in. at 110° F. Two or more stages of separation would be employed on this type of well, but it is of interest to compare the amount of pentanes and heavier fractions contained in the total gas in one, two and three stages of separation, respectively. For instance, for each 1.0 gal. contained in the total gas in a three-stage separation system, the total gas in a two-stage system would contain 1.4 gal. and there would be over 5.0 gal. in the gas liberated if the well effluent should be flashed directly in the tank at atmospheric pressure.

Although a three-stage separation system is in most instances more desirable than a two-stage system, the case might occur where omitting the secondary trap entirely and collecting only tank vapors could be justified by the attendant removal and recovery of a greater portion of the gasoline fractions from the crude oil.

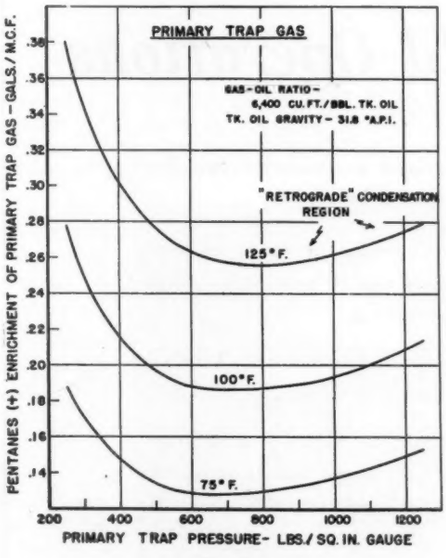
PRIMARY TRAP GAS
GAS-OIL RATIO – 6,400 CU. FT./BBL. TK. OIL
TK. OIL GRAVITY – 31.8 °A.P.I.
"RETROGRADE" CONDENSATION REGION
125° F.
100° F.
75° F.
PENTANES (+) ENRICHMENT OF PRIMARY TRAP GAS – GALS./M.C.F.
PRIMARY TRAP PRESSURE – LBS./SQ. IN. GAUGE

Fig. 5

Temperature Effect

The amount of material flashed from the crude is dependent to a considerable extent upon the system temperature. It should also be kept in mind that the system temperature is usually highest at the highest pressure and that cooling occurs when the pressure is lowered due to the liberation and expansion of the gases. Fig. 5 illustrates the effect of temperature on the pentanes(+) enrichment of primary trap gas at various primary trap pressures. It will be observed that a few degrees temperature change under some conditions might alter the enrichment as much as several hundred pounds pressure change.

Fig. 5 also shows the "retrograde" effect occurring on this particular type of gas which has a moderately high gas-oil ratio of about 6,000 cu. ft. per bbl. of tank oil. An interesting illustration of how this might affect actual operations is in the case where an operator has not yet obtained natural-gasoline plant facilities for treating the gas and whose gas is lean enough to be delivered directly into the 500-lb. per sq. in. sales gas line if precautions are taken to prevent condensation in the line. To lower the dew point of the gas the operator is considering raising the primary trap pressure to, say, 700 or 800 lb. per sq. in. However, Fig. 5 indicates that between 500 and 700 lb. per sq. in. there is very little decrease in gas enrichment, and as the pressure increases above 700 lb. per sq. in. the pentanes(+) content of the gas actually becomes greater. In such a case, it would probably be found that, except for actual processing, cooling is the only satisfactory method of lowering the dew point of the gas to any great extent.

Condensate Producing Wells

With the advent of recycling and condensate production, operations at high pressures have become of increasingly greater interest. Here again, computations based on theoretical relations are of great advantage because they supply information which is at times extremely difficult to obtain by experimental means. However, increasingly greater care must be applied in interpreting theoretical results as the pressure is increased. As the critical region begins to be approached, very erroneous results might be obtained if the proper precautions are not taken or if basic data are not first obtained by experimental means.

As a partial illustration of the types of data that might be computed for a condensate producing system, Fig. 6 has been prepared for a case where the well is producing gas-cap material and where formation conditions are at or very close to the dew point of the total well effluent. These data are for an exceptionally high gas-oil ratio of 42,500 cu. ft. per bbl. of atmospheric condensate recovered in the tank following a 500-lb. per sq. in. primary trap. The tank condensate is light in color and has a gravity of 55° A.P.I. As a matter of interest, the amounts of butanes and pentanes(+) fractions in the primary condensates are shown in Fig. 6 because such composition data are not usually obtained in actual pressure-cell tests.

The upper section of Fig. 6 (Pt. *A*) illustrates the trend in condensate recovery when the well

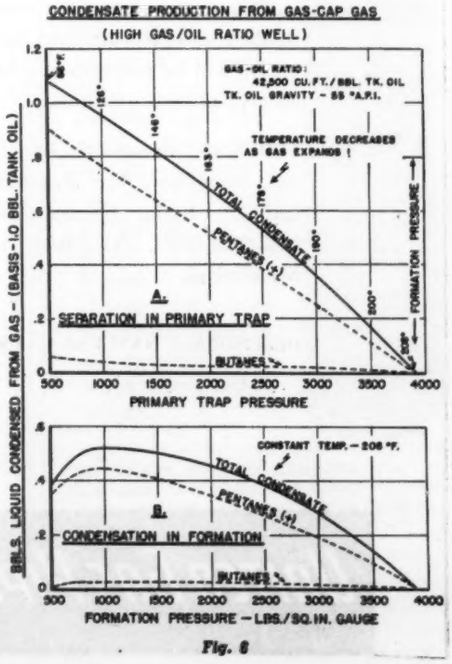

Fig. 6

effluent is expanded and separation of the resulting condensate is effected in the primary trap operated at various pressures. This plot simulates actual surface conditions where the primary trap temperature is decreased continuously due to expansion of the gas as the pressure is lowered. An interesting feature of this type of operation is that when the pressure is lowered to 500 lb. per sq. in. the cooling effect is sufficient to result in the formation of twice as much condensate as would have been obtained if the temperature had not been reduced below formation temperature. That is, the natural cooling effect doubles the amount of condensate obtained at the lower pressures.

The lower section of Fig. 6 (Pt. *B*) illustrates the amount of condensate produced from the original mixture if the pressure is lowered while maintaining the temperature at 208° F. (formation temperature). If this pressure reduction should occur within the formation itself, the curves represent the amount of condensate that would drop out in the formation. For this particular case, a reduction of about 1,000 lb. per sq. in. in pressure would result in the condensation of about 13 per cent of the pentanes(+) material present. After the condensate has wet the sand its ultimate recovery is somewhat doubtful. It is apparent, therefore, that pressure maintenance is advisable if condensation within the formation is to be avoided. In the illustration given in Fig. 6 the gas-cap gas is not very rich. It is understood, however, that there are instances where the formation gas exists at higher pressures and holds a considerably larger amount of the heavier fractions. In such cases there are indications that the amount of pentanes(+) fractions carried by the gas may be decreased by as much as 50 per cent if formation pressure is reduced to, say, 3,000 lb. per sq. in. Information of this nature is particularly useful in establishing optimum conditions for recycling operations.

Basic Data Required for Computations

Before computations can be made, it is necessary to obtain a close approximation of the actual composition of the materials present. In most problems this means that the total well effluent composition might be derived from available data. Usually this is done by making actual analyses of the gas and oil streams from the primary trap, after which a materials balance is made for the system by employing the measured volumes of oil and gas. At times when quite accurate data are essential, it is advisable to analyze and measure the oil and gas from the low-pressure tanks and traps to obtain the composition and volume of the high-pressure trap liquid. At other times, when the oil composition is sufficiently well known, it may suffice for the problem at hand to obtain only an analysis of the high-pressure gas. Having this, together with accurate data on the trap pressure, temperature and gas-oil ratio, it is possible to derive an estimate of the total well effluent composition.

Fractional analyses of oil and gas streams should be conducted through hexanes and careful inspection of the heptanes(+) fraction in the oil should be made to estimate its molecular weight. The molecular weight of the heptanes(+) fraction is either determined directly or estimated from the gravity and midboiling point or viscosity relationships. Where computations are to be made for exceptionally high pressures, it is often advisable to further divide the heptanes(+) material into two or even three fractions by employing equilibrium boiling-point data. This is essential because it is these heavy fractions that show the greatest deviation at high pressures and cause the so-called "retrograde" effect by their tendency to vaporize at high pressures.

After deriving the composition of the mixture, the equilibrium constants for individual components are obtained from available charts or are estimated and the computations are initiated. For low-pressure conditions up to, say, 500 lb. per sq. in., little difficulty is experienced in obtaining equilibrium constants that will be sufficiently accurate for most purposes. For higher pressures special care must be taken in estimating the equilibrium constants of the heaviest fractions and the two lightest fractions, methane and ethane. At pressures above about two-thirds of the critical pressure, the computed results may be questionable unless sufficient data are obtained to derive the equilibrium constants or the critical pressure for the mixture by employing pressure-cell tests.

●

A.S.T.M. Issues New Booklet On Petroleum Standards

The American Society for Testing Materials has completed its sixteenth edition of "Petroleum Products and Lubricants" which includes in one convenient binding all methods for testing, specifications, and definitions of petroleum products. An important addition to previous issues has been the elaboration of data on the testing of aviation motor fuels.

Also included this year is a standardized method of determining the ignition quality of diesel fuels, procedures for determining the aniline point and for carbonizable substances in paraffin wax. During the year some 13 standards were revised—full details are given in the annual report of Committee D-2 published in the compilation.

Copies of this book can be obtained from headquarters at 260 South Broad Street, Philadelphia, Pa., at $2 per copy, with a price of $1.50 in effect for 10 or more copies.

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UNITED GAS PIPE LINE COMPANY

H. C. Price Co. Celebrates Twentieth Anniversary

WITH the twentieth anniversary of H. C. Price Co. coming on the first of this month, attention is given to the important part of this unique organization in electric welding for the pipe-line industry.

The company was organized November 1, 1921, when a small shop was established at Bartlesville, Okla., with one welding outfit and one welder. At that time, electric welding was in its infancy, but the future possibilities of this technique were recognized by the founder and president of the organization who had been connected with metallurgical operations as chemist and metallurgical engineer.

Experiments were carried on immediately by him with the welding of pipe lines but results indicated that further developments were required to make this method of practical value for operations in the field. However, electric welding proved to be a sound procedure for tank construction. The first tank bottom ever electrically welded was contracted and built by the Price organization during the first year it was in business. This was for a 55,000-bbl. tank of the Empire Oil & Gas Co., at El Dorado, Kans.

At the end of the first year, the shop at Bartlesville was discontinued and the company specialized exclusively in the electric welding of roofs and bottoms of large storage tanks. Between then and 1928, the Price organization built more than 400 large storage tanks. In this period it welded the first floating roof and also the first breather roof.

In 1928, welding of pipe lines became practicable for the old type of bare rods used on pipe made with bell-and-spigot joints.

When Texas Pipe Line Co. undertook to lay its first major electric-welded line, which was a 200-mile, 8-in. line from San Augustine to Corsicana, Tex., laid in 1928, the welding work was handled by H. C. Price Co. Since that time, this organization has specialized in the welding of oil, gas, and water lines. To date, it has welded 11,648 miles of pipe line, located in 26 states of the United States and Venezuela. It assisted in the development of coated welding rods and took an active part in introducing such methods as stovepiping and the solid welding of large diameter pipe without the use of chill rings.

The company has headquarters at Bartlesville, Okla., and offices in Los Angeles and San Francisco, Calif., and office and warehouse at Effingham, Ill.

Among the organization's field superintendents are the following men who have had long service: C. S. Finnell, 20 years; W. A. Sims, 18 years; A. L. Broadway, 16 years; F. N. Phillips, 16 years; C. F. Jones, 14 years; E. B. Rainey, 13 years; E. J. Roth, 13 years; B. V. Elliott, 13 years; C. E. Ross, 12 years; G. M. Babaz, 12 years; Durant Worley, 11 years; R. K. Shivel, 10 years; W. C. McQuarter, 10 years.

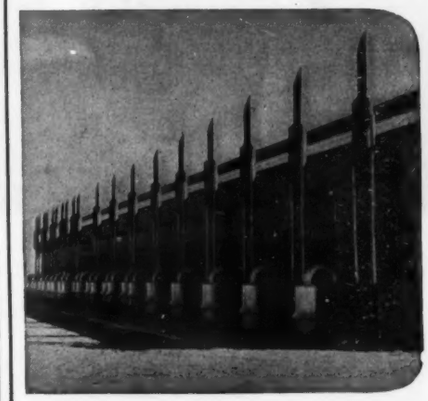
Left: Harold C. Price, president, H. C. Price Co., Bartlesville, Okla.

Right: Gant W. Fowler, general superintendent, H. C. Price Co. (Photo, Alvin C. Krupnick)

Below: Welding equipment used on the first major electric welding of a pipe line by H. C. Price Co. for Texas Pipe Line Co.'s 200 miles of 8-in. between San Augustine and Corsicana, Tex.

MAXIM
SILENCERS ON THE JOB

Maxims on an Illinois natural gasoline plant.



Maxims in New Mexico used to quiet the exhaust of Diesels totaling approximately 8000 h.p.

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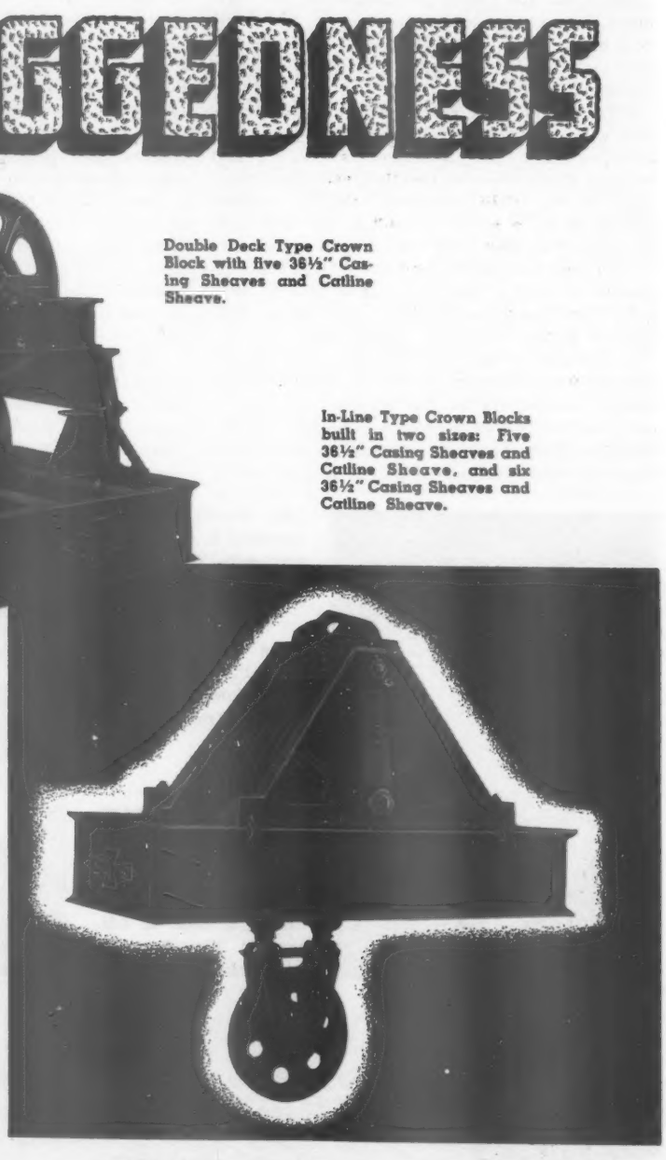

THE WHELAND COMPANY

ROTARY DRILLING EQUIPMENT

Chattanooga, Tenn.

A Review of Multiple-Zone Production in California

(Continued from Page 90)

tubing above it then is run. By placing part of the perforated tubing above and part below the packer, the well can be completed with both zones producing together through the tubing. Lowering the tubing until all the perforated tubing is below the packer allows only the lower zone to produce through the tubing, and the upper zone flows through the casing.

When subsurface control is applied, three-zone separation is achieved by using two packers on the tubing. Surface control of production from a three-zone well requires that a flow string be set with a packer between the top and middle zones. The middle and bottom zones are separated by a packer on the tubing, as in a two-zone well. Typical three-zone wells of each type are shown in Fig. 1, with the common sizes of casing and liner used.

In a three-zone well, if the flow string is smaller than the liner in which the packer on the tubing is to be set, a special packer must be set before the flow string is run. This packer usually has a seat in it to receive a packer on the tubing.

Frequently valves are placed in the tubing and flow string just above the packers. These valves are made so they open when tubing or flow string is raised, and close when it is lowered. When the well is ready to be completed, the packers are set and the valves opened. The mud then is circulated out with water, the water circulated out with oil, and the well then usually starts to flow. After all zones are flowing, the valves are closed and the zones are ready to produce separately. The well can be completed by having all zones flowing before the packers are set. However, the valves allow using one of the zones to start flow in another zone that would not flow after having been shut in. Another purpose is to use the flow velocity and pressure from one or more zones to remove the sand from the flow space of another zone which has become sanded up. Sand can be removed in this manner only if the amount of sand is not excessive, as much sand would make opening the valve impossible.

In some cases the liner size has been reduced between zones by using a special swage nipple. Separating the production has been achieved by setting a flow string, with a special lead seal shoe on the swage.

The casing and tubing head and christmas tree for a multiple-zone well separating production must provide an outlet or outlets for the flow from each zone. They usually must provide also for raising or lowering the tubing, and possibly a flow string. The surface connections can be the same as those in a single-zone well, if subsurface control is applied and all the production flows through the tubing, or in a two-zone well in which raising and lowering the tubing is not desired. A representative two-zone tree is shown in Fig. 3, and a three-zone tree in Fig. 4.

Pumping one zone of a multiple-zone well is generally a simple matter, if the gas-oil ratio is low enough. The reason for this is the fact that, due to gravity increasing with depth, the bottom zone is most heavily produced, hence it is the first to require pumping. In many cases, however, when one zone will not flow, the production is taken from the zones that still will flow. The problem of pumping multiple-zone wells has not yet become serious, but probably will provide plenty of future difficulties.

Technical Summary

The methods and procedures used to drill, complete, and produce a multiple-zone well must be varied to suit the field and even the location. The following is a brief statement of the chief considerations:

A two-zone well is relatively simple. A three-zone well is much more complex, expensive, and troublesome.

The chief problem in drilling a multiple-zone well is the separation of the zones by cement outside the liner. The best method of cementing depends upon the special conditions found in the field and well. Recementing is sometimes necessary, but the majority of the cement jobs give no trouble.

The production problems are more serious. Packers give trouble by leaking or failing to set. When sand is produced, sand blasting of tubing and casing will occur. Also, a few feet of packed sand almost can prevent removing a packer.

Repairs are difficult and expensive. In short, although multiple-zone wells may be economically desirable, they are troublesome mechanically.

Production History of Multiple-Zone Wells

Special procedures have been developed by necessity for multiple-zone wells, but comparatively little difficulty has been experienced in drilling or producing most multiple-zone wells. Table 1 gives a list of multiple-zone wells, showing the percentage that have given trouble, and the percentage of each type of trouble encountered. Repairing a multiple-zone well is difficult and expensive, and frequently the well is converted to one with fewer zones open; or the zone giving trouble is merely shut in, and flow is continued from the remaining zones.

Wilmington

The characteristics of the zones in the Wilmington field are shown in Fig. 2. The other condi-

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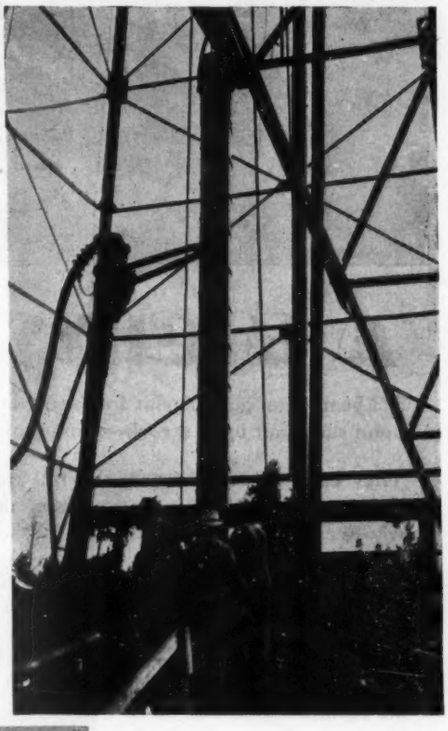

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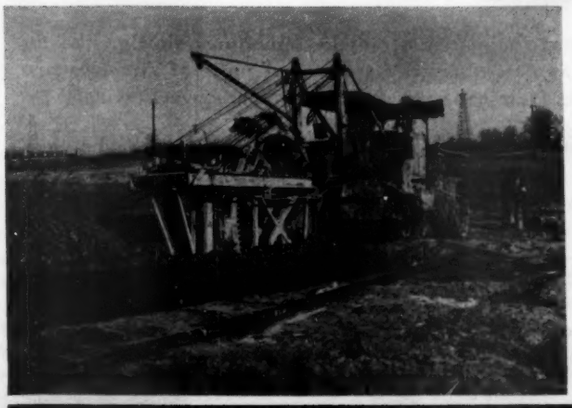

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They came to enjoy freely the full exercise of conscience—their certain way of living. They determined to *defend* that way—and preserve it as a heritage for all who were to follow them.

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For Danger is abroad and nearing us. The covetous leaders of a people who once shared our "Mighty Fortress" have taken them on ventures far beyond its shelter. The further the venture the weaker they become, and the more terrible the disaster likely to befall them.

While we of America are preparing the modern counterpart of the pilgrims' arms, let us not permit the principles upon which our Liberty is founded—our Fortress—to fall into desuetude, for these are our greatest strength. Thanksgiving Day is a special occasion for reviewing it.

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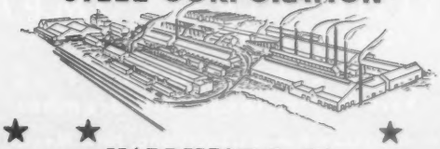

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HARRISBURG, PA.

tions which resulted in the use of multiple-zone wells are:

1. Part of the field is situated in residence and industrial districts, where surface sites are limited.

2. Many of the leases are small, with a minimum size of one acre, on which only one well may be drilled by city ordinance; therefore, the operator must provide for producing all sands from one well.

4. The leases are owned by a large number of independent operators, so that any program of orderly planned development by agreement is impossible.

Fortunately, the three main zones in the central part of the field all had high pressures, adequate gas, and a relatively long indicated flowing life.

The system is generally successful, as shown by the large percentage of Wilmington wells completed in this manner. Out of a total of 975 wells, 264 have been multiple-zone wells; 36,000 bbl. per day, or 43.6 per cent of the total field production of 82,500 bbl. per day, is so produced.

A summary of the installation difficulties and repairs required by the multiple-zone wells, without regard to field, and including only wells which do not mix the production by using side-door chokes or similar methods, is as follows:

TABLE 1

Description—	Number of wells	Percentage of total wells
1. Wells on continuous production	192	88.5
2. Circulation cut tubing	5	2.3
3. Packers leaking (repaired and rerun)	6	2.8
4. Cement plugs leaking (recemented)	2	*0.6
5. Casing collapse above packers	1	0.5
6. Bottom-hole water	6	2.8
7. Hole deepened	2	0.9
8. Change from 3 to 2 zone	4	1.8
9. Change from 2 to 1 zone	6	2.8
10. Change gas-oil ratios	2	0.9
11. Miscellaneous	6	2.8

12. Twenty-nine of the wells which have been on continuous production since their installation date show an approach toward gravity equalization for the oil obtained from the respective zones. This can be caused by any of the following:
   (*a*) Fluid-cut holes in flow string above packer.
   (*b*) Natural change in gravity due to production withdrawal from sands.
   (*c*) Packers developing leaks.
   (*d*) Cement plugs developing leaks.

None of these wells have been pulled for repair; therefore, the nature of the cause cannot be determined to date.

*Of cement-plug points.

In spite of the foregoing statistics, the present trend is away from the multiple-zone wells. This is due partly to the approach of the end of the flowing life. However, in areas separated from the rest of the field by faults, and hence undrained, the trend is also away from multiple-zone wells because of the additional recovery expected by using separate wells to each zone. The competitive area largely is drilled up, removing the principal reason for multiple-zone wells from consideration in wells now being drilled.

West Montebello

West Montebello deep-zone wells vary from 5,000 ft. to 7,600 ft. in depth—most of the wells being near the latter depth, because the deepest zone, the eighth, is the most extensive and one of the most productive.

Over a major portion of the field, the top part of the eighth zone is very gassy and is separated from the rest of the zone by a shale member. Because of the large gas volumes produced by this field, the state sets an allowable gas production for the field, and prorates it to the wells on the basis of their potential gas production. The operators, therefore, want to get the potential as high as possible. They do this by flowing all zones wide open. Then, on proration, the lower eighth zone with a low gas-oil ratio, is produced to the limit of the gas allowable and with a minimum oil curtailment. If the lower eighth zone will not flow, sufficient gas from the upper zone is admitted

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to the tubing through "side-door chokes," just above the packer, to flow the well.

Acknowledgment

The author acknowledges the kind assistance of the following persons in the preparation of this paper: E. L. Davis, Texas Co.; I. W. Butterfield, Hall Baker; O. Hamer, Security Engineering Corp., and C. E. Burt, Baker Oil Tools, Inc.

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Soviet-Mission Duty Prevents Petty From Serving District 2

Press of duties in connection with his assignment as refinery expert attached to the Harriman Mission will prevent Earl Petty from becoming district director of refining for District 2, the Office of Petroleum Coordinator for national defense reported last week.

Designation of Mr. Petty, an executive of the American Locomotive Co., New York City, as District 2 Refining Director, was announced October 11, but it has since beome apparent, the coordinator's office said, that his present assignment will require his undivided attention for some time to come. Appointment of a permanent director of refining for District 2 will be announced shortly.

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Control of Gas-Oil and Water-Oil Ratios

(Continued from Page 96)

bility of obtaining selective shutoff of water without the use of selective chemical or of previously locating the water-bearing horizon.[8] The method consists first of completely plugging the producing section of the hole, and then shooting the same section with a nitroglycerin shot of sufficient size to disintegrate the formation for a distance greater than the depth of penetration of the chemical in the tight pores, but less than the depth of penetration in the loose pores. If the tight pores carry oil to the well and the loose pores carry water, the result should be a decided decrease in the water-oil ratio. The data indicate that this ratio was reduced by a factor of 136.

Treatment of High Gas-Oil-Ratio Wells

An application of chemical plugging which has become commercially important in the last few years is in the control of gas-oil ratios. This has been practiced to the greatest extent in the Goldsmith pool, Ector County, Texas. In this pool very high gas-oil ratios were observed in many of the wells as completed, and chemical plugging has been an important and inexpensive method of reducing them. A gas cap overlies a large part of the producing horizon. Reasons assigned for the high ratios include: (1) pipe being set too high; (2) zones of vertical permeability; (3) defective cementing operations; (4) improper use of acid; and (5) shooting. Besides causing large wastage of gas and formation energy, penalties on these high ratios result in a sharp reduction of the allowable production. Remedial work is thus a primary concern of the operators in this field, and has included squeeze cementing, liner settings, packer settings, acidizing, and chemical plugging. Of these, only the last-named process comes within the scope of this paper.

In general, the same equipment and the same type of chemical are used as are employed for water-shutoff purposes. Generally a nonpenetrating gel is placed in the well up to the gas level (1,000 ft. below sea level) to protect the oil pay, and from 750 gal. to 3,000 gal. of chemical then is injected above the gel. The results on six wells belonging to the author's company are shown in Table 2. They are considered to be entirely satisfactory, and the cost of treatment was more than defrayed in the first 6 months after treatment. Results of treating the wells of another large operator in the Goldsmith pool are contained in Table 3, together with the comments of the engineers of that company.

Examination of Tables 2 and 3 indicates that chemical plugging was successful in reducing the gas-oil ratio to substantially 5,000 cu. ft. per barrel, or less, in 9 out of 11 wells, or in 82 per cent of the cases. In the two instances in which beneficial results were not accomplished, the operators report that the gas was coming from behind the pipe—obviously, a situation in which favorable results could not have been expected from chemical treatment of the exposed formations. In several cases, decreases in oil flow have been observed after treatment, but in all cases in which this reduction has brought the well below the allowable production, the situation has been remedied by a light nitroglycerin shot or by acidization of the oil pay.

Permanence of the Plug

As far as can be determined at this time, all successful treatments made with silica sols have been permanent. The first formation to which this type of plugging agent was applied is a gas well near Kane, Pa., which is still completely free from water production after 4 years. The first well treated in the Goldsmith pool now is produced on gas lift, as the amount of dissolved gas in the oil is insufficient for natural flow. Although some wells show higher gas-oil ratios at present than they did immediately after treatment, it is the judgment of the operators that this is the result of normal lowering of the gas level in the reservoir, and not the failure of plugging material.

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Conclusions

A survey of the present status of chemical formation plugging indicates that these methods have useful and economical application in three distinct fields: first, in treating cable-tool drilling wells to shut off excessive water; second, in treating producing oil and gas wells to cut down pumping costs and avoid back pressure on producing formations; and, third, in the lowering of gas-oil ratios in producing formations underlying gas caps. The Goldsmith pool is the first location where a sufficient number of wells has been treated for gas-oil-ratio control to determine the operators' chance of success, and in that field 82 per cent of the wells treated were brought substantially to or below the penalty limit of 5,000 cu. ft. per bbl.

Acknowledgment

It is a pleasure to acknowledge the author's indebtedness to Dr. Paul D. Foote and Dr. B. B Wescott, of the Gulf Research & Development Co. —the former for permission to publish the paper, and the latter for his suggestions; to T. W. Rhoads, Fort Worth district, Gulf Oil Corp.; to C. E. Reistle, Jr., of the Humble Oil & Refining Co.; and to P. E. Fitzgerald, of Dowell Incorporated, for field data and for comments on the results of chemical treatments.

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Characteristics of California Crude Oils

(Continued from Page 85)

cial true-boiling-point distillation at 25-mm. pressure in the still shown in Fig. 3.

The characterization gravity is determined on essentially all unfamiliar crude oils analyzed by Standard, and is used primarily to classify the stock as to its paraffinicity.

Heart-Cut Analysis

The heart-cut analysis is made on crude oils for which highly detailed analytical data are desired. About 15 gal. of the crude oil is run with good fractionation in a 20-gal. metal still equipped with an efficient fractionating column. Steam may be used as a distillation aid, and vacuum may be employed. The crude oil is separated into narrow-boiling cuts, each corresponding to about 5 per cent yield from the original crude oil. The narrow cuts are blended proportionately to produce a large number of gasolines, heart cuts, and residuums of different boiling ranges, and detailed inspections are obtained. The first cut usually is rectified before blending.

If the analysis is not to be carried in excess of approximately 700° F., the raw crude oil may be used in the foregoing distillation. If heavier cuts are to be made, it is necessary first to run the original crude oil to pitch without fractionation producing a blanket overhead cut, which later is rerun with fractionation to produce the narrow cuts.

The resulting data are correlated, and plotted upon charts showing the different qualities as functions of the per cent from crude oil at the start and at the end of the desired distillate. Figs. 4 and 5 are examples of charts of this type, showing the sulfur and viscosity of heart cuts from a crude oil from the Kettleman Hills field.

Conventional charts showing quality of gasolines and of residuums vs. yield from crude oil are prepared also from the foregoing data. True-boiling-point analysis, fractional analysis, and an

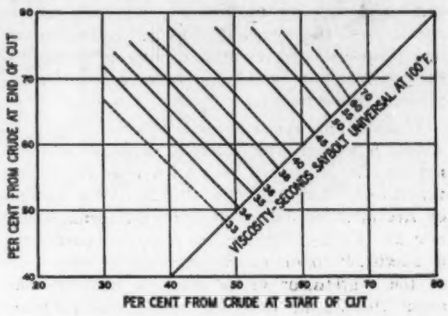


Fig. 5—Viscosity of heart cuts from 37.5°-A.P.I. Kettleman Hills crude oil

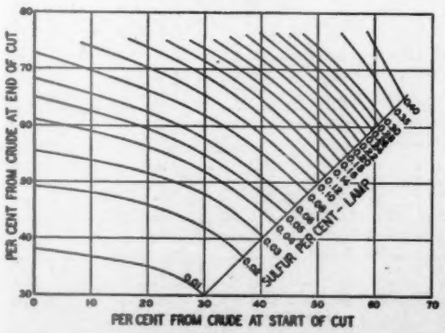
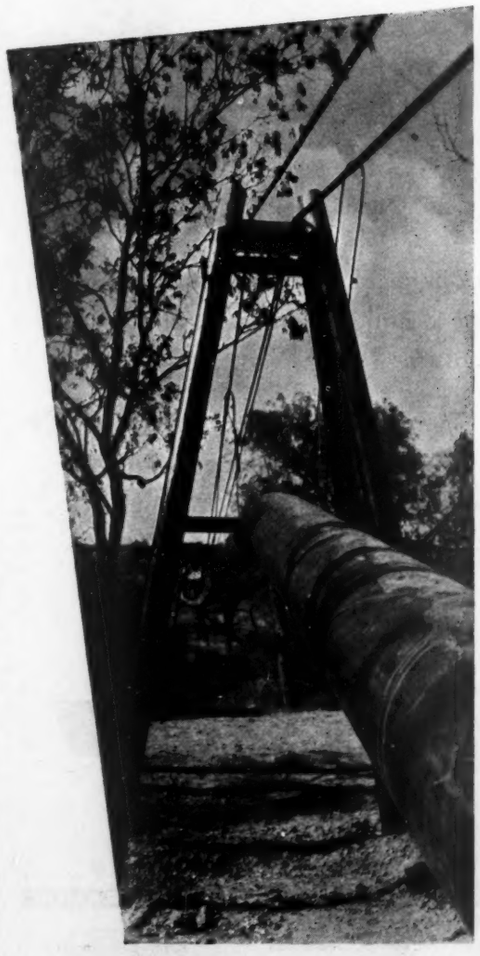


Fig. 4—Sulfur in heart cuts from 37.5°-A.P.I. Kettleman Hills crude oil

What "Selective Buying" means to you



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equilibrium-flash breakdown usually are obtained also on the crude oil as a supplement to the heart-cut analysis.

No truly satisfactory method exists for grouping or classifying California crude oils among themselves. If they are classified according to any one property, the resulting grouping is unsatisfactory from the standpoint of several other important properties.

A few approximate generalizations can be stated, however. For example, most of the more naphthenic crude oils, i.e., with characterization gravity of 23° or lower, are of 27° A.P.I. gravity or heavier. Similarly, all light California crude oils, 28° A.P.I. or lighter, are relatively paraffinic, of about 26° to 30° characterization gravity. Most of the high-sulfur crude oils are heavier than about 20° A.P.I.; however, sulfur content bears little relation to the degree of paraffinicity, and many relatively heavy crude oils are of low sulfur content.

The crude oils are sometimes classified as "refinable" and "nonrefinable." In this paper refinable crude oils are assumed to contain more than about 3 per cent of straightrun gasoline; the nonrefinable ones, less than 3 per cent. For certain purposes this grouping is convenient; however, it bears little relation to any other property of the stocks. For example, the refinable crude oils may be paraffinic or naphthenic, of high sulfur content or of low sulfur content, and waxy or nonwaxy. The refinable crude oils are usually those of higher A.P.I. gravity; however, A.P.I. gravity is not a measure of so-called refinability. For example, a 16° A.P.I. gravity California crude oil may have a gasoline content ranging from 0 to 20 per cent, and may be either nonrefinable or refinable.

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Crude oils from the San Joaquin Valley fall into two main groups, produced in about equal volume. The first group includes the heavier and more naphthenic oils, most of them ranging in A.P.I. gravity between approximately 14° and 25°, and in characterization gravity from 19° to 23°. Up to about 1930, most of the valley production was of this type. Midway-Maricopa district produces oil representative of this type.

The second group includes lighter and more paraffinic crude oils, most of them lighter than about 30° A.P.I. gravity, and with a characterization gravity between 26° and 30°. Kettleman, Coalinga Eocene, and Coles Levee are representative. Most of the production in this group is from fields opened in recent years—especially from deeper, older geologic zones.

The relationship to geologic age appears to be general throughout California. Deep wells producing from geologically older strata usually yield lighter, more paraffinic oil of lower sulfur content than do shallower wells in the same field producing from geologically younger rock.

Typical crude oil from the southern California fields is intermediate in gravity and paraffinicity between the two main San Joaquin Valley types, but is of appreciably higher sulfur content than is either of the two. However, stocks from the different southern California fields differ widely among themselves in gravity, gasoline content, paraffinicity, and sulfur content.

Most of the crude oil produced in the California coastal area resembles the lighter group of oils produced in the San Joaquin Valley. However, the coastal area also produces considerable oil of markedly different types, such as the high-sulfur, low-gravity Santa Maria Valley crude oil.

Gravity

California crude oils range in A.P.I. gravity from about 6° to 60°. The heaviest ones are essentially asphalt, and the lightest may contain more than 85 per cent of gasoline with an end point of 390° F. Most of the production in the state is within the A.P.I. gravity range of 18° to 38°. The weighted-average production in the entire state is of about 27° to 28°.

As compared to this, most Pennsylvania crude oils are of about 40° to 45° A.P.I., and Mid-Continent about 35° to 40° A.P.I. East Texas averages around 40°; West Texas is in the range of about 30° to 40°, and the two Gulf coastal types probably are in the ranges 19° to 25° and 30° to 40°, respectively. Therefore, California crude oils, on the average, are substantially heavier than are most crude oils produced east of the Rockies.

Volatility

California crude oils differ widely among themselves in volatility. Some are more than 85 per cent asphalt, and some contain more than 85 per cent gasoline.

Fig. 6 shows the relation between the A.P.I. gravity of about 500 different California crude oils

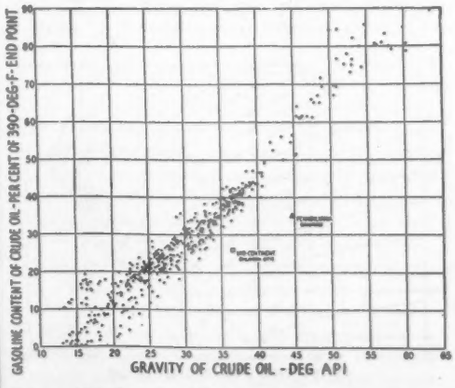

Fig. 6—Gasoline content of California crude oils as a function of gravity

and their gasoline content. As shown in Fig. 6, the lighter crude oils usually contain the most gasoline; however, the gravity of a given oil is not a satisfactory measure of its gasoline content. For example, crude oil of 16° A.P.I. gravity may contain from 0 to about 20 per cent gasoline—depending upon its source, boiling characteristics, and paraffinicity.

Points corresponding to typical Pennsylvania and Mid-Continent crude oils are included in Fig. 6. These oils contain substantially less gasoline than do California crude oils of the same gravity, due to their more paraffinic character and lower asphalt content.

The yield vs. true-boiling-point relationship for several typical California and eastern crude oils

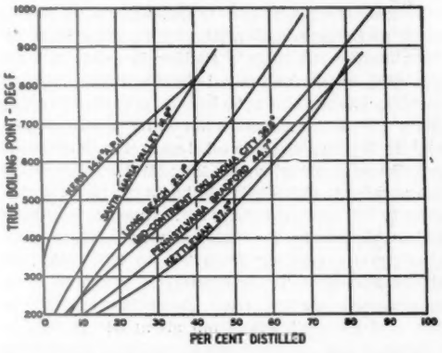

Fig. 7—Volatility of California crude oils compared with Mid-Continent and Pennsylvania oils

is shown in Fig. 7. In this regard the different California oils differ markedly among themselves. The relative percentage of oil boiling in different ranges varies considerably, and may or may not be similar to that in Mid-Continent, Pennsylvania, and Texas crude oils.

The heavier California crude oils are substantially more viscous than are most Pennsylvania, Mid-Continent, or Texas crude oils, due primarily to their higher boiling points and higher asphalt content. This leads to a problem in pipe-line transportation, due to the high pressure drop. Transportation by tanker has been adopted in many cases to avoid this difficulty.

California oils of a given boiling range are appreciably more viscous than are Pennsylvania or Mid-Continent oils of the same boiling range. This difference in in accord with the difference in paraffinicity. For example, gas oils with an average

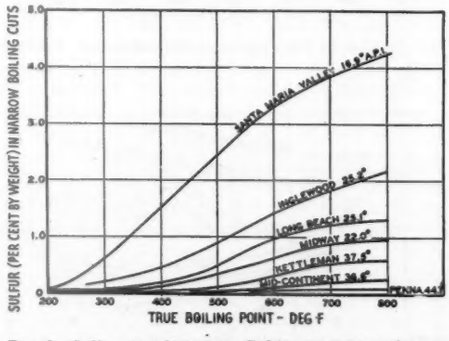

Fig. 8—Sulfur distribution in California crude oils compared with Mid-Continent and Pennsylvania oils

boiling point of 700° F. from Pennsylvania, Mid-Continent, Kettleman Hills (California), and Midway (California) crude oils have a Saybolt Universal viscosity, respectively, of 66, 71, 74, and 120 seconds at 100° F.

Residuum stocks from California crude oils are substantially heavier, both in gravity and viscosity, than are corresponding residuums from eastern crude oils. For example, residuums following kerosene distillate from Mid-Continent, Kettleman Hills, and Midway crude oils have, respectively, an A.P.I. gravity of approximately 29°, 23°, and 15°, and a Saybolt Universal viscosity of 90, 100, and 770 seconds at 130° F.

Wax-free lubricating-oil distillate from California crude oils is of a viscosity index ranging from about −200 to +30. Solvent refining and dewaxing of distillates or residuums from selected crude oils, however, produce high-quality lubricants of 90 to 100 v.i.

Sulfur Content

The sulfur content of California crude oils is, in most cases, far higher than that of Pennsylvania and Mid-Continent oils, and substantially higher than that of most Texas oils. California crude oils range in sulfur content from about 0.1 to 6 per cent. San Joaquin Valley crude oils fall into two groups: paraffinic oils of about 0.3 to 0.4 per cent sulfur content, and naphthenic oils of 0.7 to 1.0 per cent sulfur content. Average southern California crude oil contains about 1.0 to 1.5 per cent sulfur. Most Pennsylvania and Mid-Continent crude oils contain about 0.1 to 0.3 per cent sulfur, and those from Texas perhaps 0.2 to 3.0 per cent.

The sulfur distribution in several different crude oils is shown in Fig. 8. Kettleman Hills is classified as of low sulfur content; yet distillates therefrom contain two to five times as much sulfur as do corresponding Pennsylvania and Mid-Continent distillates, and about the same amount as do distillates from East Texas crude oil. Distillates from high-sulfur California crude oils, such as Santa Maria Valley and Inglewood, may contain as much as 1 to 4 per cent sulfur, or perhaps 20 times as much as does the corresponding distillate from Mid-Continent crude oil.

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nia are usually of high sulfur content, ranging from about 0.9 to 2.0 per cent, and averaging about 1.3 to 1.7 per cent. They are far more corrosive to cracking equipment than are most Mid-Continent and Texas stocks. Vessels and lines must be protected against corrosion—chrome-alloy lines and vessel lining frequently being employed. A substantial part of the cracking-unit furnaces processing California stocks are equipped throughout with 18-8 chrome-nickel tubes for corrosion protection.

The chemical character of the sulfur-bearing compounds in California crude oils is substantially different from that of the compounds in any crude oil produced east of the Rockies with which the authors are familiar. Most California crude oils, as produced, are almost free of hydrogen sulfide and are low in mercaptan-sulfur content. The raw straightrun gasolines usually are slightly sour to the doctor test, however. Texas stocks, for example, are much higher both in hydrogen sulfide and mercaptan sulfur.

In low-pressure distillation, California oils produce much less hydrogen sulfide than do Texas oils. Cracking of California residuum, however, produces considerable hydrogen sulfide and mercaptan sulfur, as well as considerable heavier sulfur compounds not of the mercaptan type.

The sulfur compounds in California cracking stock appear to be more stable to heat than are those in Texas oils. On cracking, the sulfur in Texas oil tends to form hydrogen sulfide and to appear in the gas—producing relatively low-sulfur naphtha. The sulfur compounds in California oil tend to split into compounds of intermediate boiling range and appear in the naphtha, which is of relatively high sulfur content.

A few crude oils are known in which the sulfur compounds appear to be more stable than are those in California stocks. Crude oil from Bahrein Island (Persian Gulf) and especially that from the Cut Bank field, Montana, are examples. On cracking residuums from these crude oils, the sulfur appears to concentrate in the cracked residuum, producing cracked naphtha of relatively low sulfur content.

Paraffinicity

California crude oils are substantially less paraffinic than are Pennsylvania, Mid-Continent, East Texas, or West Texas crude oils. Some of the heavy Gulf Coast oils are, however, about equal in paraffinicity to California stock.

Crude oils range in paraffinicity from certain of the highly aromatic Borneo crude oils, having a characterization gravity of approximately 15°, to highly paraffinic crudes, such as certain Pennsylvania, Michigan, and Louisiana stocks, which have a characterization gravity ranging from approximately 36° to 38°. California crude oils are grouped about halfway between these two extremes, having characterization gravities ranging from 19° to 30°. Kettleman Hills, a rather paraffinic California crude oil, has a characterization gravity of approximately 29°; Midway, a rather nonparaffinic California oil, has a characterization gravity of approximately 22°. Average southern California stocks are intermediate—characterization gravity ranging from 24° to 26°. Mid-Continent and East Texas crude oils range in characterization gravity from approximately 30° to 33°, and Pennsylvania from about 34° to 36°.

With a few unimportant exceptions, all California oils owe their nonparaffinic character to the presence of naphthenic compounds. Their naphthene content is considerably higher than that of eastern oils; their aromatic content is low, and is not greatly different from that of eastern oils. Certain Borneo crude oils are far more aromatic in character than are any California oils.

As shown in Figs. 9 and 10, the paraffinicity of

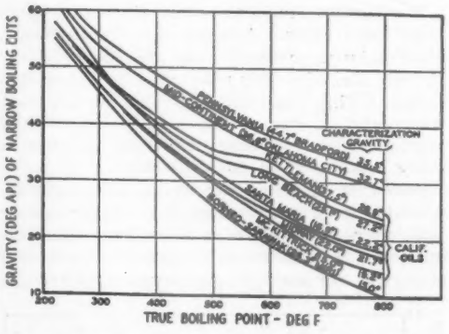

Fig. 9—Gravity-boiling-point relationship for different crude oils

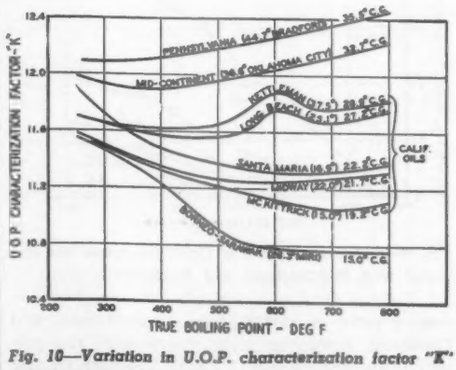

Fig. 10—Variation in U.O.P. characterization factor "K" with boiling point

California crude oils may vary considerably, depending upon the boiling range. For example, gasoline from Santa Maria Valley crude oil is quite paraffinic; whereas heavy gas oil and asphalt therefrom are quite naphthenic.

The naphthenic character of California crude

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oils is reflected in the high octane number of the straightrun gasolines. The gasolines with an end point of 390° F., after they have been blended with natural gasoline to obtain 170° F. at the 20 per cent point, usually range in octane number from 60 to 73 C.F.R. motor method. A large proportion of them is in the upper part of this range. Corresponding gasolines from the Mid-Continent, East Texas, and West Texas are usually of about 50 to 60 octane number.

The naphthenic character of California stocks also results in production of cracked and reformed gasolines of relatively high octane number.

Minor Components

The wax content of California crude oils varies greatly. The naphthenic crudes, especially those of low A.P.I. gravity, are usually low in wax and of low pour point. Residuums therefrom are usually of a pour point below about +10° F. The light, paraffinic California crude oils usually contain 2 to 4 per cent wax, residuums therefrom usually being of a pour point above +60° F. The wax is concentrated in the heavy-gas-oil and lubricating-oil distillate range. The asphalt from these crude oils is waxy, but less waxy than is the heavy gas oil.

Naphthenic acids are present in California crude oils throughout the boiling range from kerosene to asphalt. A considerable volume of naphthenic acid is recovered from the different distillates for special chemical manufacture.

Cracked naphtha from California charging stocks contains a considerable amount of nitrogen bases and phenolic compounds. Nitrogen bases can be recovered from the sulfuric acid used in finishing cracked naphthas. A substantial volume of heavy substituted phenols is recovered by caustic-washing the cracked naphthas, neutralizing, and distilling.

Refining Characteristics

California oils are of higher sulfur content, and are more naphthenic, darker in color, and less color stable, than most eastern oils. These factors lead to important differences in the refining processes required.

Straightrun Products

Most straightrun gasolines from California crude oils are treated with a small amount of acid to meet color requirements, and in many cases to lower the sulfur content and to meet the doctor test.

Most of the raw kerosene distillates are of unsatisfactory burning quality due to their sulfur and aromatic content. High-quality kerosene can be, and is, made by sulfur dioxide treatment, followed by acid treatment to meet color and sulfur requirements. The top cut from the sulfur dioxide extract is a valuable source of low-aniline-point thinners.

Raw lubricating-oil distillate from all California crude oils is of low viscosity index. The waxy crude oils yield the best distillates in this regard, but even they seldom exceed +30 v.i. after dewaxing. In a few cases acid treating and dewaxing will producing lubricating oil of better than 90 v.i. Most of the high-quality motor oils manufactured in California are produced by solvent treatment and dewaxing of waxy crude oils. The resulting product is of the highest quality.

A large volume of heavy fuel oil, composed of cracked residuum and crude residuum, is produced in California refineries. This stock is of low A.P.I. gravity, high viscosity, high sulfur content, and may be of high pour point. Blending with 10 to 20 per cent of light gas oil is necessary to meet viscosity and gravity requirements. Viscosity and gravity are substantially less critical in refineries processing crude oils produced east of the Rockies, residuums from most of which are substantially lighter both in gravity and viscosity.

TABLE 3—REFORMING OF STRAIGHTRUN NAPHTHA

Crude oil—	Midway, California	Kettleman Hills, California	East Texas	Oklahoma City
Reformer charge:				
Boiling range, °F.	250-400	250-400	250-400	250-400
Octane number, C.F.R. motor method	63.5	48	46	36
Raw reformed gasoline (end point, 400° F.; vapor pressure, 8 lb.):				
Yield, per cent by volume	80	80	80	80
Octane number, C.F.R. motor method	76	73.5	73	70

Reforming

Straightrun gasolines from California crude oils respond readily to thermal reforming. Table 3 shows results of reforming straightrun naphtha from different typical California and eastern crude oils.

The fundamental yield-octane-number relationship is believed to be the same for both California and eastern stocks; however, the California oils produce reformed gasoline of markedly higher knock rating, because the charging stocks are of higher octane number than are those from most eastern crude oils.

Raw reformed gasoline from California oils is usually of lower color than is that made from most eastern oils. In most cases treatment is required to meet color and color-stability requirements.

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Cracking

Residuum, rather than gas oil, is charged to most cracking units processing California oil. Gas-oil cracking is usually uneconomical, because the required vacuum-distillation and asphalt-viscosity-breaking steps are unduly expensive.

The residuum cracking stocks range in Saybolt Universal viscosity from about 125 to 2,500 seconds at 130° F., averaging about 800 seconds. The viscosity has been found to be the most satisfactory measure of the yield of gasoline or naphtha that can be obtained from the cracking stock. Fig. 11 shows a viscosity-yield chart for cracking California residuum in sigle-coil units, with reaction chambers of moderate size.

Gravity is not a satisfactory measure of the yields obtainable in cracking California residuums because of the wide range in paraffinicity and asphalt content of the stocks. However, all California residuums of a given viscosity produce essentially the same naphtha yield for a given cracked-residuum viscosity, whatever their gravity may be. A yield chart such as that shown in Fig. 11, is, therefore, of marked utility in plant operation and in planning the refinery viscosity balance. Viscosity balance is an important problem in California refineries, due to the high viscosity of most of the oils processed.

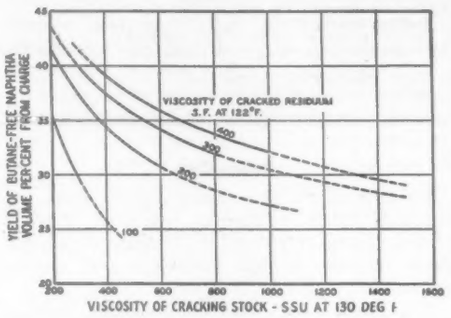
YIELD OF BUTANE-FREE NAPHTHA VOLUME PER CENT FROM CHARGE
VISCOSITY OF CRACKED RESIDUUM S. F. AT 122°F.
100
200
300
400
VISCOSITY OF CRACKING STOCK - SSU AT 130 DEG F

Fig. 11—Viscosity-yield chart for cracking California residuum

The charging stocks and cracked residuums are substantially heavier and contain more asphalt than is the case when processing most eastern oils. The cracking process occurs more in the liquid phase than is the case in the East, and coking is substantially more severe.

Fig. 12 shows the relation between sulfur content of chaging stock and cracked naphtha when processing California residuums. A large proportion of the charging stock processed in California has a sulfur content of approximately 1.5 per cent, and produces cracked naphtha with a sulfur content of about 0.8 per cent. Most of the cracked naphtha is acid-treated to reduce the sulfur content of the gasoline to a satisfactory value, and to produce good color.

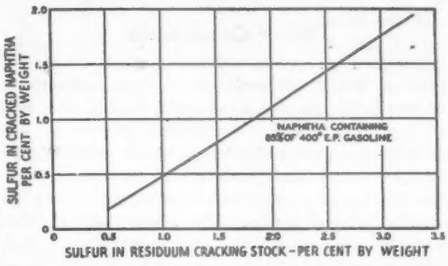
SULFUR IN CRACKED NAPHTHA PER CENT BY WEIGHT
NAPHTHA CONTAINING 85% OF 400° E.P. GASOLINE
SULFUR IN RESIDUUM CRACKING STOCK - PER CENT BY WEIGHT

Fig. 12—Sulfur relationship in cracking California residuum

Sulfur presents a far more serious problem in cracking California oils than is the case in the East. This is due in part to the high sulfur content of California oils as compared to eastern oils, and in part to the fact that most eastern cracking stocks produce cracked gasoline of far lower sulfur content than do California charging stocks of the same sulfur content.

Most California cracking stocks produce cracked gasoline of substantially higher octane number than do cracking stocks from crude oils produced in the rest of the United States. This is due to the highly naphthenic character of the stocks. Fig. 13 shows the relationship between characterization gravity of the charging stock and octane number of the raw cracked gasoline produced therefrom, in single-coil units equipped with reaction chambers of moderate size and fractionating columns operating at essentially the same pressure as exists in the cracking zone. As shown in Fig. 13, cracking stock from Midway crude oil (characterization gravity, 22°), produces raw gasoline of about 74 octane number, C.F.R. Motor Method; whereas, a Mid-Continent crude oil, with a characterization gravity of approximately 32°. would produce gasoline of about 67 octane number.

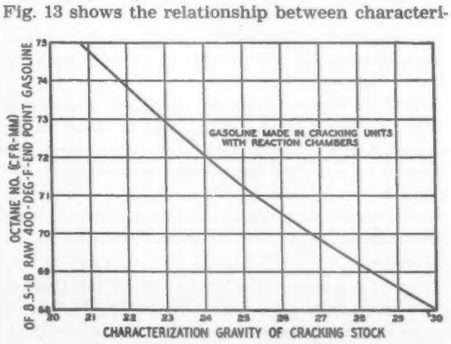
OCTANE NO. (C.F.R.-MM) OF 8.5-LB RAW 400-DEG-F-END POINT GASOLINE
GASOLINE MADE IN CRACKING UNITS WITH REACTION CHAMBERS
CHARACTERIZATION GRAVITY OF CRACKING STOCK

Fig. 13—Octane number of gasoline from cracking California residuum

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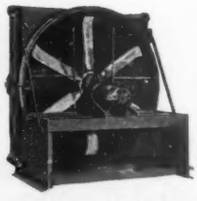

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Progress in METALS

By W. L. NELSON

X-Rays Put to Work in Defense

THE mammoth million-volt X-ray equipment shown in Fig. 1 is brought to bear on large castings or vessels much as a dentist swings his small equipment toward a patient except that the million-volt equipment is so large that a crane is necessary in hoisting and maneuvering the 1,500-lb. assembly. The main tube is 3 ft. in diameter by 4 ft. long. X-rays issue from the tube on the end of the drum and with proper hoisting equipment it is possible to aim the rays in almost any direction. In addition to mechanical aiming of the rays, they may also be deflected to the side by electrical means; thus they can be sent from the inside of a drum as indicated in Fig. 2. The rays pass directly through welds as thick as 7 in. Film is attached on the far side of the object and any irregularities in the way of cracks, seams, voids, inclusions, etc., are clearly discernible in the finished picture. For typical radiographs refer to "X-Ray Examination . . . Safeguards . . . Industry" in the July 15, 1937, issue of The Oil and Gas Journal.

The development of the million-volt X-ray machine is the culmination of 10 years of research and plant development work by General Electric Co. and its clients. A few years ago a painstaking technique and cumbersome aids were necessary to disclose cracks that were ½ in. in depth in welds that were 4 in. thick. Today cracks ⅛ in. in depth in 6-in. thickness welds can be detected readily. The million-volt equipment has also reduced the time required to only one-sixtieth of that required several months ago. This may be emphasized in another way by stating that until recently the time consumed in examining a vessel was sometimes as long as all the rest of the time required for manufacture or fabrication. In describing the use of the equipment C. D. Moriarty, of General Electric Co., made the following comments on the reactions of a metal chipper as he digs into fault sections of metal: "It is amusing to watch the face of an uninitiated chipper when he is told where to chip, how far below the surface to go, and what he will find when he gets there. His look of patient resignation turns to something akin to awe, with that 'What won't they think of next?' look."

The million-volt equipment, heretofore used in only a few hospitals for cancer treatment, is now speeding America's defense efforts in four great factories; Babcock & Wilcox, Combustion Engineering, Ford Motor, and General Electric. In the near future, similar equipment will be installed at the American Steel Foundaries Co., the Norfolk and Philadelphia Navy yards, and at the Campbell, Wyant and Cannon Foundry Co.

Babcock & Wilcox Co., a fabricator of large vessels for the petroleum and other industries, was one of the first (July 17) to install the million-volt equipment. O. R. Carpenter, of this company, states that 4½-in. steel welds can be penetrated in approximately 2 minutes. In the past, 90 hours of exposure time was required for this depth of penetration when using 400,000-volt X-rays, or 60 hours of time when using 200 mg. of radium, as against a few minutes with the new X-ray equipment. He also estimates that about 100 g. of radium (at a cost of $2,500,000) would be required to match the short length of time of the million-volt equipment. Fig. 3 indicates the installation in the Babcock & Wilcox Co. plant. A 64 by 15 by 10 ft. pit having about 18-in. walls is used to hold the vessels during X-ray examination and to protect workers from the rays. Operations are controlled from a nearby room and automatic warning lights are situated in and about the pit to warn workmen concerning operations.

In summary, the million-volt equipment requires far shorter exposure times, the time being in the magnitude of minutes as compared with days by the older equipments; thicknesses up to 7 or 8 in. can be handled whereas about 4 in. was the upper practical limit of the earlier 400,000-volt machines; the images are somewhat clearer than with earlier equipment and even better operation is expected after more experience is gained; and the compact mechanical arrangement of the new equipment, which utilizes a radically new type of transformer and gaseous dichlordifluormethane as the insulating medium, results in a relatively light and portable machine.

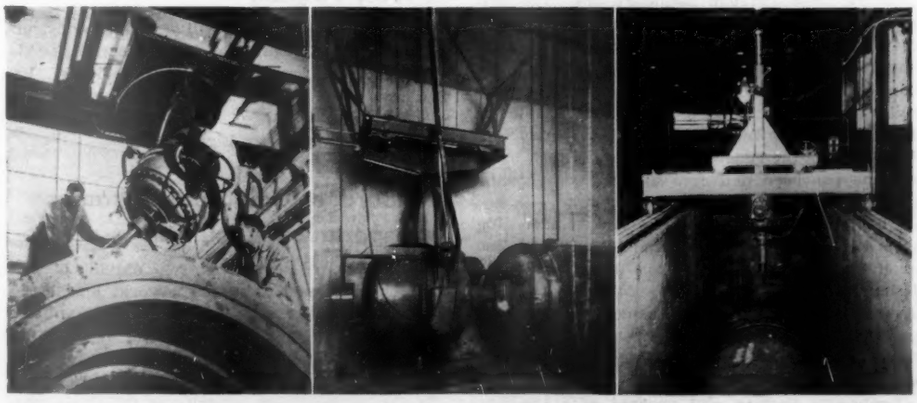
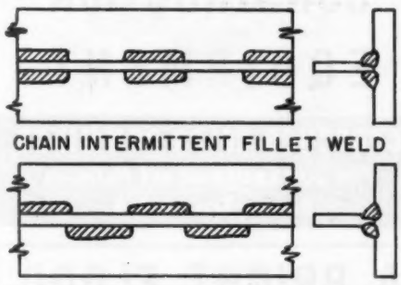


Fig. 1 (left)—Using the million-volt industrial X-ray equipment at a 45° angle in the Schenectady Works Laboratory of General Electric Co., showing preparation for an inspection of a casing. Fig. 2 (center)—Combustion Engineering Co. application of million-volt X-ray tube, showing how tube of target is inserted into pressure vessel for inspection of weld. Fig. 3 (right)—View of Babcock & Wilcox company million-volt X-ray equipment installation, showing part to be X-rayed in concrete pit.

Welding Terms

Flush, Tack, and Intermittent Welds

A flush weld is one in which a minimum of reinforcing weld metal is employed. In special cases the excess weld metal is planed off flush with the surface of the plate. This results in a somewhat stronger weld under conditions of fatigue because of elimination of irregularities in the surface.



A tack weld is used for preparation or assembly purposes only.

An intermittent weld is one whose continuity is broken by unwelded spaces. Two ways of making such a weld for a tee joint are shown in the attached sketch.

Good News Concerning Manganese Shortage

A DEFINITE assurance of the possibility of sizable manganese production from our domestic sources is given in a recent report of the U. S. Bureau of Mines. Manganese deposits have long been known in this country but they contain a low percentage of manganese. The Bureau of Mines now reports that it has been successful in producing rich concentrates from the low-grade deposits of the Las Vegas (Nev.) region.

Several pilot plants have been built under defense appropriations and the first of these pilot plants is now in operation at Boulder City, Nev. A recently completed test run using the process developed in the Bureau of Mines laboratories indicates definitely that the process is successful and that at least part of our requirements of manganese can be met by the use of domestic ores.

Manganese is vital in the manufacture of almost all steel or ferrous products—and heretofore only about 3 per cent of our needs have been produced at home. Most metallurgists have felt that manganese is the most strategic alloy element. With a method of utilizing domestic ores, it may be possible to make our large stock-piles of manganese ore last for many years.

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Pipe-Line Activity

Gulf Will Lay Lines In Crane, Tex., Area

Construction of an additional pipe-line outlet for the Sand Hills field, Crane County, Texas, is planned by the Gulf Oil Corp. Recent developments and higher oil production have made the line necessary.

An 8-in. main line will extend 18 miles from its station at Crane to two pumping units in the field, 18 miles. These units have a daily capacity of 12,000 bbl. The company will also build 23 miles of field line and erect two tanks of 80,000 bbl. each in the field and another 80,000-bbl. tank at Crane.

Outlets for Illinois Fields Are Enlarged

Sohio Pipe Line Co.'s crude-oil system was enlarged last month by the completion of three loops of approximately 3 miles each, totaling 10 miles of 12-in. As a result, the capacity of the line between Stoy, Ill., and Hagerstown, Ind., is increased materially.

Illinois Pipe Line Co. has laid nearly 50 miles of line in recent weeks to expand its system. Included in this program are 12 miles of 8-in. near Bridgeport, Ill., and 6 miles of 6-in. near Wood River, Ill.

Work referred to undertaken by the Sohio and Illinois companies has been done by Sheehan Pipe Line Construction Co., general contractor, and by H. C. Price Co., welding contractor. The Price organization is also starting this week on the welding of 9 miles of 16-in. for American Rolling Mill Co. to increase deliveries of natural gas for the plant at Middletown, Ohio. The pipe will be laid by the company's maintenance and construction organization.

Meramec Oil Co. has laid 5½ miles of line from the Johnsonville area to the Baltimore & Ohio railroad tracks at Cisne, Ill.

Panhandle Eastern Will Start 166-Mile Michigan Line Soon

Panhandle Eastern Pipe Line Co. will commence construction the middle of this month for a line approximately 166 miles long which will branch from the main trunk line at a point near the Ohio-Michigan boundary line. The new pipe line will connect with Flint and Clawson, Mich. It will be laid in the vicinity of Pontiac, Saginaw, and Zilwaukee, Mich. The line will consist of approximately 28 miles of 20-in., 25 miles of 18-in., 32 miles of 16-in. and 36 miles of 12-in. The line will be welded by H. C. Price Co.; I. C. Little is the general contractor. Fifteen miles of pipe has been delivered already; other shipments are scheduled for early delivery.

The immediate program undertaken according to present plans will not include the 82-mile line extending west through Jackson and Marshall to Kalamazoo, Mich., which was contemplated this summer when Panhandle Eastern was making preliminary provisions for expanding its facilities. However, this line is slated for construction next year.

Panhandle Eastern will proceed with the laying of 45 miles of 8-in. from Galesburg to Peoria, Ill., after pipe has been made available which the company is removing from its system in eastern Kansas.

J. D. Creveling, president of the Panhandle Eastern Pipe Line Co., told a Federal Power Commission hearing last week that his concern planned expenditures of $6,800,000 in 1942 for expanding its service in Michigan.

He added that expanding defense activities in that area indicated that a continuous growth was under way and his company was planning to be capable of meeting all demands.

Mr. Creveling testified in closing the defense of the Panhandle company, whose general rate structure has been under investigation by the Power Commission since July.

Examiner Samuel H. Crosby said the Michigan Gas Transmission Corp. had requested a continuance of the hearing to November 17, and he was planning to recess the proceeding today in order to comply with the request.

The hearing began in July when the city of Detroit and Wayne County charged the pipe-line company and the transmission corporation with "unjust and discriminatory rates" for natural gas sold to the Michigan Consolidated Gas Co. for resale in Detroit, Mich., and vicinity. The Power Commission then began an investigation of the pipe-line company's rates.

Gasoline Pipe-Line Shipments Break Records This Year

Pipe-line transportation of gasoline was far larger in the first 8 months of 1941 than in the corresponding 1940 period. In August the largest volume was turned into lines of any month in history.

Motor fuel turned into lines in the first 8 months totaled 73,763,000 bbl., against 61,715,000 bbl. in the first 8 months of 1940, according to U. S. Bureau of Mines figures. In August the total was 10,669,000 bbl., against 9,996,000 bbl. in July, and 8,806,000 bbl. in August 1940.

Motor fuel delivered from lines in the first 8 months totaled 72,882,000 bbl., against 61,990,000 bbl. in the corresponding 1940 period; and for August 10,288,000 bbl., against 10,494,000 bbl. in July, and 9,429,000 bbl. in August 1940.

Stocks in lines and working tanks at the end of the month totaled 5,621,000 bbl., against 5,301,000 bbl. a month earlier, and 4,525,000 bbl. a year earlier.

Hope Lays 46 miles In West Virginia

Hope Natural Gas Co. will complete construction work in the middle of this month for 46 miles of 12-in. from Ripley to Waverly, W. Va. The laying of the line is now in progress with welding done by H. C. Price Co. and general contracting handled by Ligin & Ligon.

Standard of California Revamps Transportation Facilities

Restoration to service of two old oil barges, one of which made a round-the-world journey in World War I has been announced by Standard Oil Co. of California as part of the program to step up oil movement because of the diversion of eight tankers to Maritime Commission use.

It also is increasing capacity at terminals, particularly at the Richmond, Calif., refinery, where $415,000 is now being spent on work which will cut tanker unloading time from 2 working days to 1. The increase in nine terminals, including storage at various points as far north as Alaska,

Pipe-Line Personalities . . . . Robert E. Young

ROBERT E. YOUNG, manager of Oklahoma pipe lines for Pure Transportation Co., grew up and went to school in Indiana and Illinois. In the spring of 1904, at the age of 16, he worked in a pipe-line gang for Ohio Oil Co. in the Casey and Martinsville areas of Illinois. After another year of school he went to the oil fields in Indian Territory and the Gulf Coast. In the 3 years following the opening of Glenn Pool he worked for Gulf Pipe Line at Kiefer, Okla. In this period he was advanced to material superintendent. Later he worked for Production Transportation Co. in the Bakersfield and Coalinga fields in California and for the Standard Oil Co. of California at Taft, Calif. For a while he was a barging and boating contractor serving oil companies in Louisiana.

In 1909 he went with the old Muskogee Refining Co. in Oklahoma. Two years later he joined the Pure Oil Co. and had charge of installing refinery equipment at Ardmore, Okla., and supervising pipe-line construction. Later he was in charge of construction and operation of the company's plants at Cushing, Okla., and Heath, Ohio, during the World War I period. In 1920 he was in charge of refineries and pipe lines at the company headquarters at Tulsa.

In the last decade when the company discontinued refinery operation in his territory he has been concerned principally with crude-oil purchases and pipe-line operation. He and his wife maintain a residence in Tulsa. His son, Louis Nixon Young, a graduate from Oklahoma University in mechanical engineering, is employed in the refinery of Globe Oil & Refining Co. at McPherson, Kans. His daughter, Jesse Lucille McCrum, is married to the chief refinery engineer of Talco Asphalt & Refining Co., Talco, Tex.

is being carried out. The whole program, inaugurated as the result of tanker diversions, is costing $2,140,000.

Army Develops Portable Gasoline Pipe Line

Portable pipe lines that can be readily moved for installation over difficult terrain to carry gasoline supplies to motorized units in the field, have been developed recently by the Army.

The new pipe line comes in self-contained half-mile units, each complete with a centrifugal pump driven by a 20-hp. gasoline engine, according to Army Motors, the publication of the Motor Transport School at the Holabird Quartermaster Depot, Baltimore, Md. Each half-mile unit can be moved by cargo trucks and used independently of any other unit.

These self-contained sections, alone or in combinations, are said to be able to deliver gasoline through swamps and forests or over mountains at a rate of approximately 200 gal. per minute. The pipe also can be used to assist or even replace floating gasoline tanks for ship-to-shore operations.

Lion Refining Buys Line From Grady Vaughn

Lion Oil Refining Co. of El Dorado, Ark., has purchased from Grady Vaughn of Dallas, Tex., his gas pipe line from the Magnolia to Atlanta pools, both in Arkansas. The line consists of 30,000 ft. of 6-in. line and 11,000 ft. of 7-in. pipe. Lion plans to utilize the line for carrying gas from the Atlanta pool to its Magnolia desulfurization plant, where it is converted into commercial gas for the Lion's El Dorado refinery.

Pipe Lines Move Rock Island Crude From Cement to Indianapolis

Rock Island Oil Co. has started crude-oil runs through its new pipe line from the Cement field in Caddo County, Oklahoma, for delivery to the new plant of Rock Island Refining Corp. at Indianapolis, Ind.

The company nominated through Anderson-Prichard Oil Co., 6,000 bbl. daily from the field for November. Anderson-Prichard gathers all of the oil in the Cement field and delivers it to other purchasers.

Anderson-Prichard is taking 8,000 bbl. daily to its own refinery at Cyril, Okla., and at the Cyril terminal is delivering 2,000 bbl. daily to Magnolia Petroleum Co. The oil is run from Cyril through the old Anderson-Prichard 4-in. line from Cyril to the Walters station on the Magnolia trunk line.

The new Rock Island line is about 30 miles of 6-in., extending from the field to the Knox station of the Oklahoma Pipe Line Co., northeast of Marlow in Stephens County, Oklahoma.

Cities Service Will Start Cement-Oklahoma City Line

Construction is expected to start in 2 weeks on a 16-in. natural-gas line from the Cement field, Oklahoma, to the Oklahoma City area, since pipe now is being delivered at south end of the line.

This carrier is being constructed by the Cities Service Oil Co. and Ray Stephens, Inc., the former company having operation of the line. It will tie into the Cities Service trunk system from Oklahoma City, Okla., to southern Kansas.

At present Cement is served by the Oklahoma Natural Gas and the Consolidated Gas companies, but their requirements have not been sufficient to permit full production from some of the leases on the west side of the field.

Lacy Plans Gathering System for Hawkins Field

Rogers Lacy, Longview, Tex., producer and refiner, will give the Hawkins field in Wood County, Texas, new outlet facilities with completion of a planned gathering system. Mr. Lacy will connect 13 producers he has in the field, and also seek outside connections. The oil will be moved out by rail. Humble is the other purchaser in the field.

By a trade with Delta Drilling Co., Tyler, Tex., Mr. Lacy obtained a gas line from Kilgore to Gladewater to the field. In the trade, Delta obtained a gas-line system owned by Lacy in the north part of the East Texas field.

Delta will use the system to distribute gas on completion of carrier from Chapel Hill field.

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TULSA, OKLAHOMA

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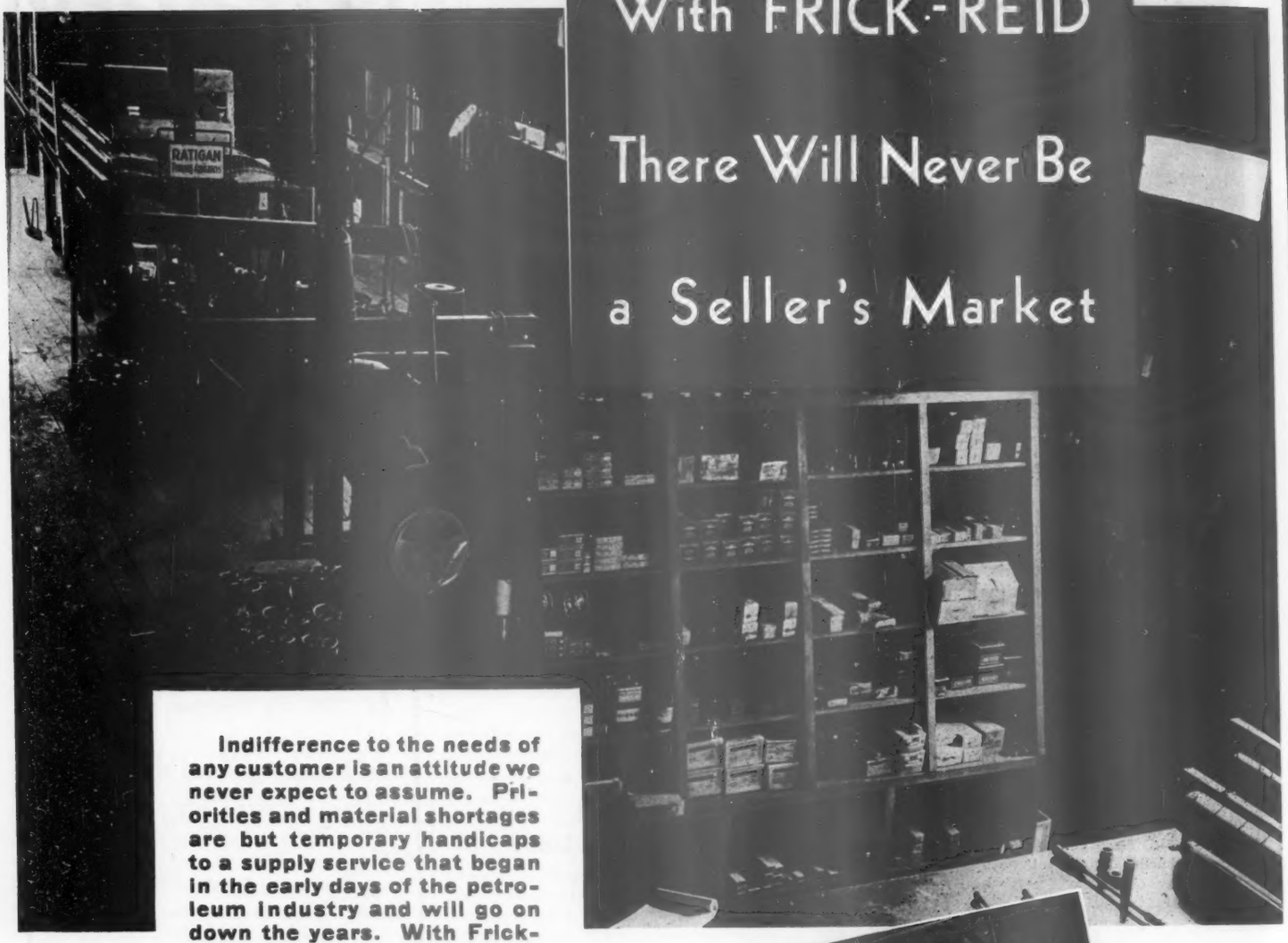

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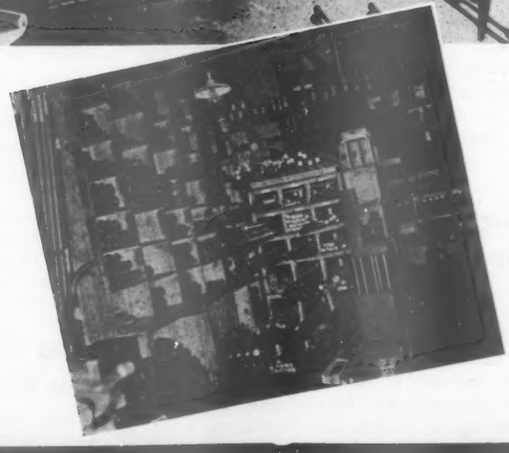

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TULSA, OKLAHOMA

FIELD DEVELOPMENTS...

HIGHLIGHTS FROM THE WEEK'S NEWS—

Results of the summer wildcatting campaign were evident in many areas last week as flush production was beginning to flow from new fields. Most spectacular was still Michigan's Reed City pool, but Oklahoma's Apache strike, coupled with potential of the Cement field, was causing a shift of the state's production system west into Caddo County and West Texas was spreading as fast as new oil could be handled. Best outlook for Wyoming was still the high-grade Tensleep production from the Lost Soldier-Mahoney dome trend, while the Wilcox trend play along the Texas and Louisiana Gulf was moving toward the north and into deeper zones with success.

The nature of the summer discoveries, moreover, was such that continued exploration was necessary before development programs could get into full swing. Strikes in the areas mentioned, as well as in far western Kansas, opened vast possibilities either because of their location in regions far removed from production or because they tapped new horizons that may spread over wide areas. Thus, much of the extensive wildcatting under way last week was to test the extent of these earlier strikes. Only California was lagging in exploration, but even there extreme depths were being tested for new reserves.

Completions reported for the week were still at a record level, though they dropped off from 705 for the previous week to 657. Unseasonable rains that blanketed the entire central portion of the United States from Illinois to Texas accounted for much of the drop, particularly in Kansas which has been battling floods and blizzards for weeks. Full effects of floods and knee-deep mud in Oklahoma, North Texas and Illinois will not show in completion reports for another week.

ARKANSAS: Exploration of the prolific Nacatoch sand was spurred by discovery of a producing spot 4½ miles east and slightly south of the old East Stephens field. Shallow depth (1,616 ft.) makes the zone particularly attractive (p. 205).

NORTH LOUISIANA: First failure for large area between Larto Lake and Cypress Bayou was reported. Exploration continued with eight active tests in a 7-mile radius in spite of the depth of production (p. 205).

NORTHERN WEST TEXAS: A third new pool was opened in the exploration of Ordovician and Permian zones in the Abell area. The South Apco pool was to get an enlarged drilling program and a new wildcat was staked west of Fort Stockton (p. 217).

SOUTHERN WEST TEXAS: Wildcat east of the north end of the Kermit pool will be completed in the lower Permian instead of being deepened to the Ellenburger (p. 217).

EAST TEXAS: A small pumping well was being completed 3 miles north of the East Texas field in Upshur County. If it makes a commercial producer, a new play is expected between the strike and the field. Wildcatting continued at a fast pace in other areas with five new tests announced (p. 222).

KENTUCKY: Production was pushed 7 miles west in Union County with a Pennsylvania sand strike estimated at 75 bbl. a day. It was an offset to a recent deep test that failed (p. 206).

CALIFORNIA: Demand for heavy crude to meet a growing fuel-oil market has stepped up drilling in San Joaquin Valley, particularly at Kern River, Midway-Sunset, Mount Poso and Round Mountain. Several wildcats in the valley, however, were abandoned. At Dominguez tubing was found pinched in some of the wells killed by earthquake and they may have to be redrilled. Status of the deep zone at Rincon was unchanged by performance of the present test which is not a big enough producer to be profitable (p. 202).

ILLINOIS: St. Peter sand was found dry at Louden and the test was being plugged back to the Devonian, newest of the fields's four pay zones. Prospects of St. Peter production anywhere in the basin were considerably lessened by the Louden failure since a similar test recently at Salem was also dry. New pools were in prospect for Clay and Richland counties and the Parkersburg field of Richland County was extended southwest into Edwards County (p. 212).

KANSAS: Thirty-second pool of the year was opened in Rice County. It may prove to be an extension to the Bornholdt-Welch area chat production. Between Zenith and Peace Creek there was still a chance for Viola production after the Misener was found dry. A new well was showing on the northeast flank of the Barton arch near McPherson County's Lindsborg pool (p. 215).

OKLAHOMA: Cement field had another sand added to its score of producing zones and production at the new Apache pool nearby was pushed one location east by a big well. Sufficient outlets have been built or are under way to assure both fields of opportunity to expand. Logan County's Guthrie townsite wildcat was a failure, but new pools were showing in Pottawatomie and Stephens counties. West Hotulke Wilcox was extended and the Lincoln county play held steady with a new test announced (p. 200).

NORTH TEXAS: Three areas in Clay County and one in Jack County are scheduled for intensive drilling campaigns following recent discoveries. Another Caddo lime pool was opened in Throckmorton County (p. 209).

COLORADO: A new gas zone was added to reserves at West Hiawatha. The old Florence field, second oldest in the nation, laid claim to one of the oldest wells in the country which has worn out three derricks (p. 219).

LOUISIANA GULF COAST: Good shows of oil and gas at a wildcat in northern Rapides Parish indicated that Wilcox production would be extended north from the play in Central Louisiana. Exploration along the entire Wilcox trend was affected by completion of the second well in the new deepest zone opened at Neale. The entire area was humming (p. 201).

WYOMING: Another dome on the Lost Soldier-Mahoney trend was being tested for Tensleep production. The well logged shows in the Frontier sand and was going on down (p. 219).

WEST CENTRAL TEXAS: Operations continued on the increase in and around the Wimberly area which had new spacing and proration rules. A ½-mile south extension was showing (p. 209).

COMPLETIONS IN ALL FIELDS . . .

(Week Ended November 1, 1941)

	Oil	Gas	Dry	Total	1941 total comp. to date	1940 total comp. to date
N. Y., Pa., and W. Va.	95	27	6	128	4,993	4,711
Ohio	19	17	16	52	1,423	1,277
Indiana	10	0	4	14	431	365
Kentucky	2	5	0	7	558	496
Illinois	71	1	22	94	3,093	3,221
Michigan	10	2	4	16	756	974
Kansas	14	0	11	25	1,820	1,552
Nebraska	1	0	0	1	75	37
Missouri, Iowa	0	0	0	0	32	30
Oklahoma	17	3	11	31	1,596	1,588
Texas:						
North Central Texas	37	3	23	63	2,304	2,355
West Texas	51	0	1	52	1,915	1,607
Texas Panhandle	12	4	0	16	564	487
Eastern Texas	19	0	2	21	902	522
Texas Gulf Coast	13	1	10	24	917	1,007
Southwest Texas	23	0	18	41	1,572	1,789
Total Texas	155	8	54	217	8,174	7,767
North Louisiana	7	2	7	16	646	550
Louisiana Gulf Coast	6	0	3	9	721	858
Total Louisiana	13	2	10	25	1,367	1,408
Arkansas	7	0	1	8	170	144
Mississippi and Southeast	6	0	1	7	234	171
Montana	3	0	1	4	246	200
Wyoming	1	0	0	1	153	140
Colorado	0	0	0	0	27	13
New Mexico	6	0	1	7	236	539
California	19	0	1	20	938	858
Total United States	449	65	143	657	26,322	25,491
Total previous week	480	82	143	705		
Week ended Nov. 2, 1940	405	67	125	597		

Service on Active Fields

NEWHALL-POTRERO, LOS ANGELES COUNTY, CALIFORNIA

Compiled by The Oil and Gas Journal

Geographic location

In Newhall-Castaic quadrangle, about 35 miles northwest of Los Angeles, 5 miles northwest of Newhall and 3 miles southwest of Castaic.

Location of supply houses

All supply houses and distributors maintain large stocks in Los Angeles. Branch stores have been opened at Castaic.

Trucking and hauling facilities

Field hauling and trucking facilities are ample.

DEVELOPMENT

Early development

Barnsdall Oil Co. 1 Rancho San Francisco in 26-4n-17w, the discovery well, was completed May 2, 1937, flowing 150 bbl. of clean 35.2°-gravity oil daily from the interval 6,160-6,472 ft. in the Modelo formation of Miocene age. Since then, two additional zones in the upper 1,000 ft. of Modelo have been proved and developed. In addition, there is believed to be at least another 5,000 ft. of Miocene sediments below present production with additional possibilities for oil and gas.

Subsequent development

A total of 23 wells have been drilled and completed in the field, all producers. Since completion of the discovery well, the field has been extended in southeasterly and northwesterly directions so that the proved area is now more than 1 mile in length. Production is at present limited to Sections 26 and 27-4n-17w of the San Bernardino Base and Meridian. There are two strings of tools in operation in the field and locations staked for two additional wells.

Production and proration

In the absence of compulsory regulation, all curtailment is on a voluntary basis to which most California operators adhere. Present production of the field is 3,140 bbl. per day and cumulative production of the field to August 31, 1941, is 1,892,133 bbl.

Spacing program

The field is being developed on 10-acre spacing.

OWNERS OF PRODUCING WELLS

The discoverer, Barnsdall Oil Co., has drilled and owns all wells completed on the structure to date. The Rancho San Francisco on which production has been developed is owned by the Newhall Land & Farming Co.

GEOLOGY

Method of discovery

Geological reconnaissance and field work supplemented by seismograph.

General geology of the field

The structure is anticlinal and only the northwest plunge has been developed up to the present time. Several small cross faults are present. Porosities and permeabilities of oil sands increase with penetration and depth and to date the third Modelo zone is the most favorable from a formation and productive standpoint. The Modelo is marine in character and contains alternate shale and massive sand bodies. There are about 4,500 ft. of Modelo exposed in the general area. The lower Modelo has not been explored but is expected to contain oil and gas in commercial quantity.

FUTURE DRILLING

Proved area

Development has proved up about 400 acres but limits of production have not been determined by dry holes.

Undrilled locations in proved area

It has been the policy of Barnsdall to develop the field conservatively by drilling a few holes along the trend of the structure and then offsets in the most desirable directions. All locations selected and drilled resulted in production.

DRILLING CONDITIONS

Type of equipment used

All drilling is by the rotary method with gas-engine rigs using 136-ft. derricks. Two 350-hp. engines are connected to the draw works and two 225-hp. engines drive the 7¼ by 14-in. power pumps connected in parallel.

Water in the field

Water is available in the field for drilling mud and on treatment can be used in steam boilers. However, for reasons of economy gas-engine power is used rather than steam.

Casing program

It is the present practice to cement 13⅜-in. surface casing at 300 ft. followed by a 7-in. water string over the producing horizon and a 5½-in. perforated liner. Production is flowed through 2½ in. tubing.

Drilling mud

Drilling mud of 75 lb. and 29 sec. viscosity is used. Ten to 15 sacks of mud are added each tower to keep the water loss down to 30 cc.

Type of bits used

Rock bits are used in drilling operations in this field. Approximately 65 rock bits are required to drill a well to a depth of 7,200 ft.

Drilling time

Approximately 45 days are required for drilling from spud to completion.

DRILLING PROBLEMS

Difficulty has been encountered with sticking drill pipe when pulling out of the hole. This trouble has been minimized by keeping the mud-water loss below 30 cc., by running stabilizers above the bit, and using bumper subs in the drilling string after trouble develops.

PRODUCING PRACTICES

All wells flow naturally to a central gathering plant consisting

of high and low-pressure separators, oil and gas meters and tank storage. Production is controlled at the well head. All production is clean so there are no dehydration or oil cleaning facilities.

PIPE-LINE OUTLET

Oil is pumped from the field storage about 4 miles by pipe line to two 37,500-bbl. tanks located on one of the major pipe-line systems from whence it is shipped via pipe line to Los Angeles and vicinity.

GAS-OIL RATIO

While the gas-oil ratios vary somewhat in the three productive zones they average approximately 950 cu. ft. of gas per barrel of oil.

SAMPLE FROM 2 RANCHO SAN FRANCISCO OF BARNSDALL OIL CO.

Specific gravity	0.862	Saybolt Universal viscosity at	
Sulfur, per cent	0.52	77°, sec.	55
A.P.I. gravity, degrees	32.7	Saybolt Universal viscosity at	
Color	brownish black	100°, sec.	48

Hempel Distillation

GASOLINE			
Gravity, °F.	56.9	Recovery	97
I.B.P.	98	Residue	1.0
10 per cent	170	Doctor test	negative
20 per cent	200	Color	23
30 per cent	223	Octane No. (L-3 method)	60
40 per cent	244	BOTTOMS	
50 per cent	260	Per cent	64.5
60 per cent	284	Fire, °F.	270
70 per cent	304	Cold test, max., °F.	70
80 per cent	329	Gravity, degrees	22.9
90 per cent	359	Viscosity at 210°, sec.	48
End point	400	Cold test, min., °F.	30
		Flash, °F.	235

SAMPLE FROM 4 RANCHO SAN FRANCISCO OF BARNSDALL OIL CO.

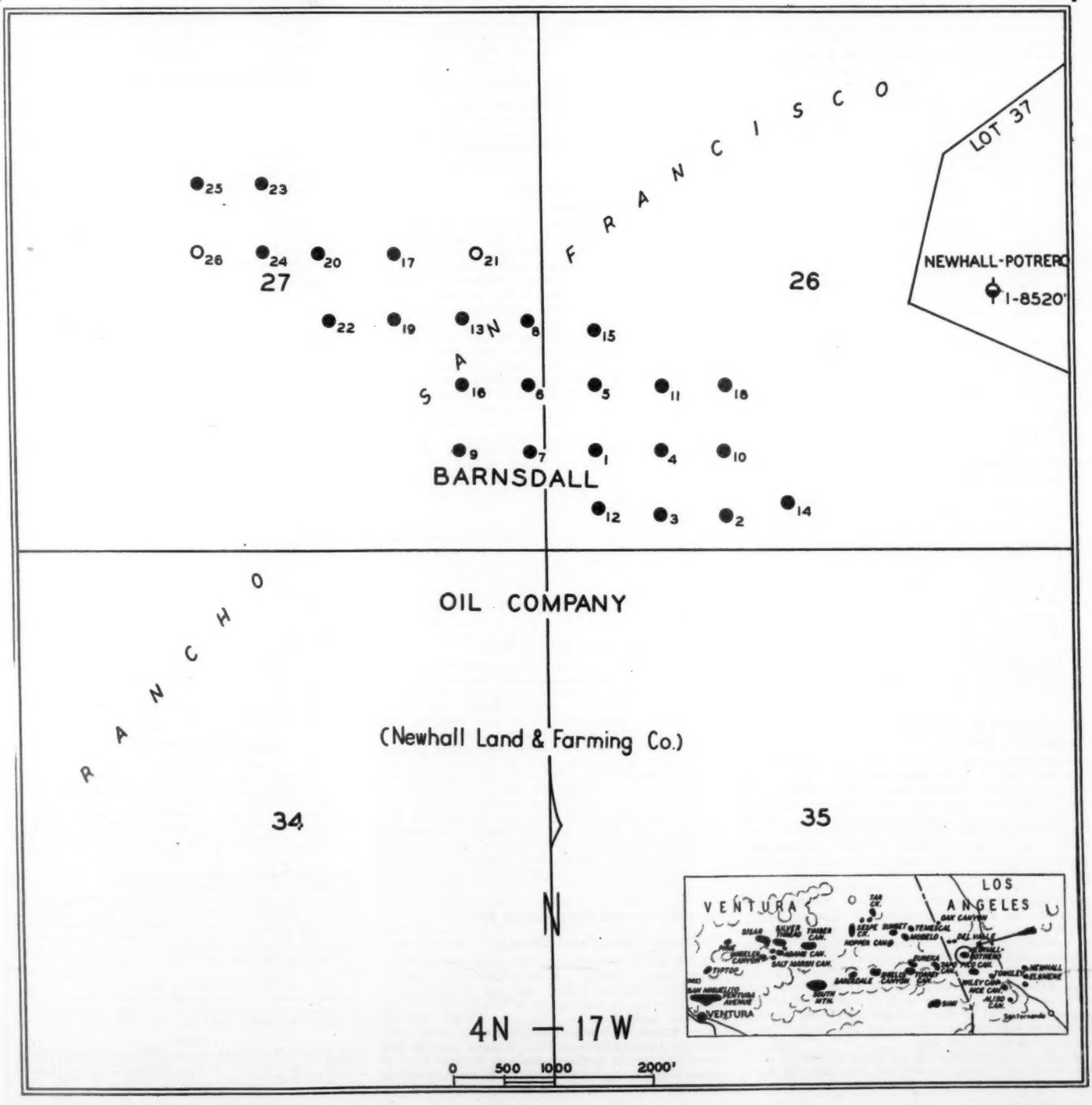
Gravity at 60°, A.P.I., deg.	36.6	Paraffin, per cent	2.03
Asphalt at 80°, per cent	20.76	Sulfur, per cent	0.38

Distillation

Tops, net at 500°F., 54.1° A.P.I., per cent	47

COMMERCIAL PRODUCTS

U. S. Motor gasoline per cent		39.40
	A.P.I. gravity	Per cent
Gasoline, 437 end point	57.1°	39.40
Kerosene stock	36.8°	7.60
Gas oil	34.2°	11.48
Residuum	18.5°	41.52



OKLAHOMA FIELD REPORT

Apache-Cement Area Leads State for Regional Gain

By ROBERT INGRAM

THE southern edge of the great Anadarko basin in the region centered on the Cement and Apache pools of Caddo County last week was clearly emerging as a major new producing area for the state. At the same time it was becoming increasingly evident that general areas which hitherto dominated the state's operating picture were doing well to hold their own. Plight of established producing regions was made clear by the November allowables prorated by the Corporation Commission (see p. 66).

In spite of an unusually high rate of drilling and wildcatting in all parts of the state, new pools were scarcely offsetting the decline in production anywhere except in Caddo County. Even West Hewitt in Carter County, which has been almost spectacular in drilling and production so far this year, was clearly on the downgrade. At midweek, there were only 13 operations in the field, and 4 of them were deepening jobs, one a location. On an allowable of 11,000 bbl. in September, the field averaged 10,621 bbl. daily. For November the quota was cut to 8,500 bbl., and there are doubts as to whether the pool will make that figure. Development of the new zone opened a few weeks ago has not started, and apparently will be delayed until the present Ward or "Fourth" sand zone is depleted. There are now two producers in the new zone which is below 2,900 ft.

Outstanding new pools in Pottawatomie and Seminole counties—Tecumseh Lake, East Tecumseh, Romulus, South Maud and North St. Louis—were reaching peak production quickly and passing the flush stage. The 2-year campaign in Okfuskee County was nearing an end after opening a score of local highs that had little effect on the total production for the area. Logan County's Guthrie pool was falling off fast after reaching a daily average of 3,687 bbl. from 20 wells in July. Cumberland, in Marshall County, was still an isolated development although of major importance. Secondary recovery projects and new drilling in the even older northeastern areas, including Osage County, were just about keeping output steady.

New Sand Opened at East Edge of Cement Pool at 6,000 ft.

On the other hand, Cement, which already is producing from some 20 different zones after more than 20 years of development, had still another producing sand last week, its output had increased by 50 per cent from last spring and pipe-line construction in the area indicated that prospects for continued expansion were excellent.

The new sand, dubbed the Marchand and Kistler, was opened by Ohio Oil Co. and Ramsey Petroleum Co. in the northeast sector of the 10-mile long field at 12 Wade, NE SW SE 2-5-9w. Drilled to 6,052 ft., casing was set near the bottom and perforated with 53 shots at 5,900-18 ft. The hole filled 5,000 ft. with oil in 6½ hours and the well was estimated at 700-800 bbl. capacity.

New Pipe Lines at Cement Boost Production to 12,000 Bbl.

While the average 10 active operations in the field was less than at some other areas, lack of pipe-line outlet has held scores of wells far below capacity for many years and new wells were still coming in at potentials as high as 3,000 bbl. New pipe-line connections have permitted runs to jump from around 7,000 bbl. a day to 12,000 bbl. for the last 3 months and progress of two other pipe-line projects last week indicated even higher runs to come.

Rock Island Oil Co. started operating its new line from Cement to the Knox station of the Oklahoma Pipe Line Co. northeast of Marlow in Stephens County whence crude moves to the new Rock Island refinery at Indianapolis, Ind. The company nominated, through Anderson-Prichard Oil Co., operators of the field's only gathering system, 6,000 bbl. a day for November and Anderson-Prichard is taking 8,000 bbl. a day. 6,000 bbl. for its refinery at Cyril and 2,000 bbl. for delivery at Cyril to the Magnolia Petroleum Co. for its trunk line south. Production has largely been based on outlet in the past.

At the same time construction was scheduled to start this week on a 16-in. natural gas line from the field to the Oklahoma City area. This outlet, being built by Cities Service Gas Co. and Ray Stephens, Inc., will tie into the Cities Service trunk system from Oklahoma City to southern Kansas and will permit increased oil production from the high gas-oil ratio wells on the west side of the field.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: Fields	16	4,772	37,459
Wildcats	1	34	4,215
Gas wells: Fields	1	*4.5	1,728
Wildcats	2	*7.3	8,777
Dry holes: Fields	8	.....	23,431
Wildcats	3	.....	10,627
Total	31	.....	86,237
Recompletions	5	975	.....

*Million cu. ft.

New Producer at Apache; Outlet Through Seminole Assured

Meantime, the Apache pool, 8 miles southwest of Cement, was extended one location east by Texas 1 Maynahonah, SW SW NE 2-5-12w, which flowed 195 bbl. of oil in 1 hour through open casing from Wilcox sand at a total depth of 3,600 ft. Pinched to 1-in. choke on tubing the well averaged 80 bbl. an hour and when pinched through a 23/64-in. choke, it was averaging 34 to 35 bbl. hourly.

This was the fifth producer for the pool of which four are owned by the Texas Co., discovery operators. Initial production for these wells has run from 900 bbl. to 5,000 bbl. daily and has been proven in both the first and second Wilcox sands. There are 12 operations listed for the field, some of which have been delayed in starting on account of bad weather.

On top of these developments came confirmation by the pipe-line division of the Texas Co. of reports that it had started purchasing right-of-way for an 8-in. crude-oil line from Apache to the Seminole district, a distance of 101 miles. The company recently completed a line from the Apache field to a loading rack near the Apache townsite where it is building an 80,000-bbl. storage tank and installing pumps.

The new line will extend from the townsite connection through the Cement field, thence to near Purcell, where it will cross the river and run on into the Seminole district. It will tie into the Texas-Empire Pipe Line Co. transcontinental trunk system at Seminole.

Apache Trend Wildcat Running High

Exploration in the Apache-Cement area was concentrated last week along a trend running southeast through Comanche County from Apache. Denver Producing & Refining Co. 1 Luella Hayes, one of several wildcats along this trend, was checking very high, according to reports, and cored the upper Bromide zone at 2,315-25 ft. Five short cores showing oil stains were pulled to 2,359 ft., where crews were reaming down the hole. It was in hard sand. Electric log was run and pipe was to be set around 2,380 ft.

The Texas Co. also has three wildcats along this trend which continued operations in spite of bad weather. They were 1 Gamble, SW NE SE 5-3-10w, southeast of Elgin, drilling at 4,967 ft. in brown lime; 1 School Land-A, SW SE NW 13-3-10w, drilled at 6,371 ft., and 1 School Land-B, SW SW 13-4-11w, drilling at 3,921 ft.

New Starts and Discoveries Are Scattered Throughout State

Skelly Oil Co. followed up its lease play and successful wildcats (Skelly 1 Kilmer, NW SE SE 26-17-3, and Haddock-Moore 1 Hert, SW NE SE 22-17-3) in Lincoln County by staking a new test in NE NW NE 2-13-2 on geophysical reports. . . . West Hotulke, second Wilcox, in Pottawatomie County was extended south by Atlantic Refining Co. 1 Nesbitt, SE NW NW 27-9-4, one of 24 active operations in the area; it swabbed 16 bbl. an hour from total depth 4,689 ft. in the sand. . . . Glen Grimes of St. Jo, Tex., and H. W. Fair of Fort Worth, Tex., opened a new field south of the old Woolsey area in Stephens County at 1 Baker, NW SW NE 35-2s-6w; it flowed through casing an estimated 400 bbl., 30 gravity from sand at 1,851-55 ft. . . . Kerlyn Oil Co. had show of a discovery at 1 Kirk, NW NE SW 1-8-4, north of Maud in Pottawatomie County, from a little free oil in a drill-stem test of dolomite at 4,322-45 ft. and a first Wilcox sand core at 4,405-11 ft. . . . C. W. Roodhouse of Ada and Phillips Petroleum Co. are awaiting amendment by the Corporation Commission of a 10-acre spacing order before starting a test to the Cromwell sand at N½ SW NE 28-2-6 in West Fitts, Pontotoc County.

Guthrie Townsite Wildcat Is Dry Hole

Harry A. Miller of Edmond, Okla., late last week announced that his 1 Katschor, N½ NE SW 7-16-2w, near the Guthrie townsite in Logan County, would be abandoned. A second drill-stem test from 4,810-30 ft. in the second Wilcox filled the hole 4,500 ft. with water and only a trace of oil. An earlier test at 5,785-5,830 ft., plug-back depth, showed 300 ft. of oil and 700 ft. of brackish water. Total depth was 5,926 ft. in very hard sand.

There was general belief at Guthrie that another test would be drilled on the structure this winter. Mr. Miller has an expensive lease block, and performance of the Katschor well set off a lively buying and trading boom for a time when the well was first found to be checking high against an old dry hole.

AVERAGE DAILY PRODUCTION
LEADING OKLAHOMA FIELDS

	Nov. 1	Oct. 25
Allen	4,150	4,150
Billings	6,375	6,300
Burbank	8,500	8,400
South Burbank	7,750	7,650
Balance Osage	18,700	17,900
Blackwell district	3,400	3,350
Bristow-Slick	6,500	6,350
Cement	11,750	12,200
Coyle	4,200	4,100
Crescent	1,450	1,425
East Cromwell	4,450	4,325
Cromwell	2,850	2,800
Cumberland	7,150	7,200
Cushing-Shamrock	8,750	8,750
Dill	2,450	2,400
Duncan	3,350	3,400
Edmond	3,250	3,175
Fish	4,050	4,025
Fitts	10,650	10,500
Jesse	1,975	1,950
Graham-Fox	2,075	2,050
Guthrie	3,350	3,350
Healdton	8,375	8,425
Hewitt	17,200	17,100
Keokuk	2,975	2,875
Konawa	1,025	975
Lucien	6,700	5,675
Moore	900	875
Northeastern counties	17,400	17,450
Oklahoma City	86,350	84,450
Olympic	1,650	1,625
Ramsey	4,675	4,650
Sasakwa	1,150	1,075
Sholem-Alechem	2,500	2,450
Stroud, East	1,900	1,875
Seminole district:		
Bowlegs	5,650	5,550
Carr City	2,125	2,125
Dora	1,250	1,150
Earlsboro	3,525	3,500
East Earlsboro	1,550	1,575
South Earlsboro	550	550
Little River	6,175	6,175
East Little River	575	600
Mission	1,200	1,200
Seminole	6,050	6,125
East Seminole	850	850
Searight	1,875	1,850
Total Seminole	31,375	31,250
St. Louis-Pearson	17,200	17,250
Tatums-Tussy	5,125	5,150
Wewoka	1,550	1,700
Yale-Jennings	3,450	3,400
Total Oklahoma	436,500	425,450

OKLAHOMA COMPLETIONS

Wildcats

Creek County: Shell 1 Palmer, SW NW SW 6-19-9, pumped 34 bbl. oil and 2 bbl. water from Booch 2,954-3,000 ft., T.D. 4,215 ft., *discovery*.

Garvin County: Ohio 1 Freeman, SE SE SE 14-1-1w, dry, T.D. 4,365 ft., top Fennsylvanian 2,470 ft.

Kerlyn 1 Butterly, NE NE SE 22-1-1, old well worked over, T.D. 5,005 ft., shot various zones 2,330-2,769 ft., dry.

Jefferson County: Seitz-Comegys-Seitz 1 Barrett, SE SE SW 10-6s-6w, dry, T.D. 2,005 ft.

Lincoln County: Skelly 1 Mary Kilmer, NW SE SE 26-17-3, gaged 2,420,000 cu. ft. gas, pay 4,425-60 ft., dense 4,420 ft., dolomite 4,435 ft., first Wilcox 4,448 ft., 7-in. 4,506 ft., T.D. 4,506 ft., *discovery*.

Superior 1 Foquet, NE NW 17-13-6, dry, T.D. 4,257 ft., Hunton 4,237 ft.

Seminole County: Sooner Oil & Gas 1 Pechacek, SW NW SW 12-10-7, location abandoned.

Deep Rock 1 Work, NE NE NE 20-8-8, gaged 4,750,000 cu. ft. gas, 870 lb. R.P., lower Gilcrease 3,188-3,215 ft., 5-in. 4,263 ft., T.D. 4,271 ft., *discovery*.

Fields

North Bebee, Pottawatomie County: Champlin 1 Walker, NE NW NW 16-5-5, pumped 240 bbl., Hunton 2,176-2,429 ft., acid, 7-in. 2,170 ft., T.D. 2,431 ft.

East Cromwell, Okfuskee County: Shell 6 Van Pelt,

NW NE NW 35-11-8, 1,245 bbl., Cromwell 3,450-65 ft., T.D. 3,465 ft.

Shell 1 Tiger-A, NE NE SW 35-11-8, 1,379 bbl., Cromwell 3,404 ft., T.D. 3,422 ft.

Shell 2 Curry-B, SE SW SW 26-11-8, 496 bbl., Cromwell 3,488-3,502 ft., T.D. 3,503 ft.

Shell 3 Smith, NW SE SW 26-11-8, 568 bbl., pay 3,468-75 ft., T.D. 4,102 ft.

Dill, Okfuskee County: Johnson & Martin 2 Lehmar, NW NE NW 35-12-8, dry, T.D. 3,677 ft., Cromwell 3,637 ft.

South Fitts, Pontotoc County: Moore 2 Statler, SW SW SW 34-2-7, old well drilled deeper, T.D. 1,850 ft., pumped 28 bbl. oil and 6 bbl. water, pay 1,803-50 ft.

West Hewitt, Carter County: Smith 13 Ward, SE NE NE 19-4s-2w, old well, old T.D. 2,109 ft., T.D. 2,232 ft., shot 2,054-2,232 ft., flowed 372 bbl.

Neustadt 3 Choate, W½ NW NW 20-4s-2w, old well, old T.D. 1,955 ft., T.D. 2,125 ft., flowed 240 bbl.

Hotulke, Pottawatomie County: Mid-Continent 2 Krouch, SE NW SE 26-9-4, dry, T.D. 4,510 ft., Wilcox 4,508-10 ft.

Isom Springs, Marshall County: George Snell 1-A fee, NE NW SW 31-7s-6e, pumped 15 bbl., T.D. 474 ft.

Knox, Grady County: McCasland 1-A Polson, SE SE SW 27-3-5w, pumped 32 bbl., pay 1,457-69 ft., 7-in. 1,457 ft., T.D. 1,469 ft.

Phillips 1 Core Hole, T.D. 3,590 ft., moved off.

Oklahoma City, Oklahoma County: Barnsdall 4 Edwards, NW SE SE 15-12-3w, old well, old T.D. 6,436 ft., P.B. 4,150 ft., pay 4,095-4,108 ft., pumped 324 bbl. oil and 194 bbl. water.

Phillips 3 Classen, NW SE NW 15-11-3w, location abandoned.

Phillips 2 Roberts, SW SE NW 15-11-3w, location abandoned.

Otoe City, Noble County: Superior 1 Robedeaux, NE NW NE 21-22-1, dry, T.D. 4,760 ft., Wilcox 4,730-55 ft., 7-in. 4,755 ft.

Rusk, Okfuskee County: Margay 1 Turner, NE NE SW 7-11-8, flowed 317 bbl., Cromwell 3,690 ft., 7-in. 3,690 ft., T.D. 3,694 ft.

Seay, Jefferson County: King Brothers and L. S. Dennis 1 Taylor, SE SE NE 18-7s-5w, dry, T.D. 865 ft.

St. Louis, Pottawatomie County: Sinclair 3 Rice-B, NW NW NE 17-7-4, pumped 235 bbl., dolomite 4,028-40 ft., acid, 7-in. 4,126 ft., T.D. 4,127 ft.

S. and D. Daube 2 Garrett, SE SE SW 23-7-4, old well, old T.D. 4,301 ft., T.D. 4,386 ft., pumped 11 bbl. oil and 3,100 bbl. water.

Magnolia 4 Tul-Fike-G, SW NW NE 29-7-5, old well, dry, old T.D. 4,166 ft., P.B. 3,594 ft.

East St. Louis, Pottawatomie County: Barnsdall 1-A Quinn, NE SE NW 16-7-5, dry, T.D. 4,340 ft., second Wilcox 4,336 ft.

Eagle 6 School Land-C, NW NW NE 16-7-5, dry, T.D. 2,802 ft., Calvin 2,791 ft.

Velma, Stephens County: Magnolia 31 Dillard, SE NW NE 2-2s-5w, pumped 54 bbl., 8-in. 419 ft., T.D. 697 ft.

Miscellaneous

Creek County, Glenn pool: Sinclair Prairie 44 Kiefer, SE NE SE 17-17-12, old well completed as repressure well at base Glenn sand 1,544 ft.

Okmulgee County: Cline 1-A Fife, SE SE NW 25-15-13, 4,500,000 cu. ft. gas, sand 1,704 ft., T.D. 1,728 ft.

L. W. Cranston 11 McMullen, SW NE SW 3-14-14, dry, T.D. 1,214 ft.

E. Walker 5 Moore, SE SE SW 1-13-13, dry, T.D. 1,263 ft.

Minshall & Lowry 3 Simms, NE NW SW 33-16-11, pumped 30 bbl., Glenn sand 2,021 ft., 6-in. 2,051 ft., T.D. 2,076 ft.

Osage County: Oliphant 6 Osage, NW SE SW 11-24-10, pumped 75 bbl., Bartlesville 1,837-1,970 ft., 6-in. 1,838 ft., T.D. 1,970 ft.

Oliphant 5 Osage, NE SW NW 11-24-10, pumped 20 bbl., Bartlesville 1,845-1,956 ft., 6-in. 1,879 ft., T.D. 1,964 ft.

M. Norris 14 Osage, NW SE SW 15-21-12, pumped 3 bbl. oil and some water, Bartlesville 1,293-1,330 ft., 6-in. 1,285 ft., T.D. 1,330 ft.

Tulsa County: Mid-Co 1-A Tiblow, SE NW NW 9-21-13, pumped 3 bbl., Tucker 1,285-1,301 ft., T.D. 1,301 ft.

J. C. Elledge 4 McKee, NW SE NW 7-19-11, flowed 50 bbl. oil and 500,000 cu. ft. gas, Skinner 1,400-33 ft., 6-in. 1,335 ft., T.D. 1,434 ft.

OKLAHOMA DRILLING REPORT

Creek County: Deep Rock et al 1 Meadors, SE NW NE 16-15-7, Mississippi 3,445 ft., Woodford 3,821 ft., Sylvan 3,853 ft., Viola 3,906 ft., dense 3,933 ft., dolomite 3,935 ft., show oil 3,951 ft., running 7-in. to test.

Hughes County: H. G. Marshall et al 1 Neff, W½ SW SE 27-5-10, drilling 4,120 ft., in Atoka.

Keener Oil & Gas 1-A Norton, NE NE NW 6-9-10, drilling 1,578 ft.

Lincoln County: Big Chief 1 Barrett, S½ SW NE 20-13-6, perf. in Hunton 4,183-4,210 ft., acid, est. 12,000,000 cu. ft. gas, 1,350 lb. R.P.

Wilcox Oil & Gas 2 Royer, NW SW NE 18-14-6, Prue 3,228 ft., cored 3,229-36 ft., recovered shaly sand with some show oil, 7-in.

Allied Materials 2 Peck, NE SE NW 35-14-6, flowed 376 bbl. oil in 5 hr. from dolomite 4,149 ft., T.D. 4,118 ft.

Blackwell Oil & Gas 1 Dollison, NW NW NW 33-15-5, T.D. 3,550 ft., 7-in. 3,535 ft., standard tools.

Leader Oil 1 Morrow, SE NW NW 5-15-6, old well, old T.D. 3,780 ft., Mississippi 3,809 ft., drilling 3,833 ft.

Muskogee County: France Paris 1-A Clark, E½ SE NE 32-13-19, H.F.W. 145 ft., T.D. 160 ft., to ream down and lower 10-in.

(Continued on Page 214)

LOUISIANA GULF COAST

Northernmost Wilcox Pool Likely in Rapides Parish

By F. L. SINGLETON

NEW ORLEANS, La., Nov. 3.—Production from the lower Wilcox sand, recently opened in the Neale field, Beauregard Parish, was extended about 4,000 ft. northwest as Atlantic Refining Co. 3-B Rice Land & Lumber Co. flowed at the rate of 372 bbl. of pipe-line oil daily through a 5/32-in. choke. Tubing pressure was 1,800 lb., and casing pressure 2,025 lb. Casing was cemented below 11,000 ft., and the well is testing through perforated casing at 10,998-11,028 ft.

The sand is slightly deeper than the company's 5 Musser-Davis Lumber Co. located on the south side of the field completed several weeks ago at 10,880-96 ft. Prior to the discovery of this deep sand all production in the field had been from the upper Wilcox at approximately 8,300 ft., and the limits of the field were believed to be fairly well defined. This is the deepest production to be found in the Wilcox and future exploration along the entire trend has been affected by the discovery.

Casing Set on Rapides Parish Test Near Catahoula Lake

In the South Catahoula Lake area, northern Rapides Parish, M. H. Marr 1 Eota Realty Co. was attracting attention to the shallow Wilcox play as casing was being cemented for a production test following a series of side-wall cores which is reported to have showed favorable indications. The Wilcox was reported topped at approximately 4,017 ft., and the hole is bottomed at 7,068 ft., with shows of oil and gas logged at 4,528-40 ft., 5,150-57 ft., and from 5,789-92 ft.

The well is located in 14-4n-3e, on a block of approximately 4,000 acres which was recently taken over from Chamblee & Pitts. It is about 8 miles southeast of Chamblee & Pitts 1-A Lee Lumber Co., a dry hole recently abandoned below 6,000 ft. The completion of the well for a commercial producer would open the most northerly production along the coastal Louisiana sector of the Wilcox trend and extend the play now taking place in Central Louisiana.

Wilcox Test Started in Morganza Area

In Pointe Coupee Parish, location for a Wilcox test was made by Humble Oil & Refining Co. in the Morganza area. The well is located on the Pointe Coupee Land & Improvement Co. lease in 68-4s-8e, in an area which has been worked extensively with geophysical instruments. Other tests are contemplated. In St. Landry Parish as Ohio Oil Co. took a 60-day option on large block in the Grand Coteau area, and if geophysical work is favorable two wells are to be drilled. The block was taken by Atlati Royalty Co., and centers in 85-7s-4e. In the Lake Latanier area, Avoyelles Parish, Fred Bates is expected to announce location for a test on the Snowden estate in 33-3n-5e. The proposed location is about 2½ miles southwest of H. C. Cockburn 1 Snowden recently abandoned after logging favorable showings in the Wilcox at 6,600-6,700 ft.

Pine Prairie West Flank Deep Test Staked

Another producer was added to the east flank of the Pine Prairie dome, Evangeline Parish, as Gulf 1 Easton Townsite flowed at the rate of 275 bbl. daily while testing through perforated casing at 8,120-30 ft. Tubing pressure was 1,250 lb. In the meantime C. I. Production Co. was preparing to test 3 Evangeline Land Co. after sand was logged at intervals from 8,233-88 ft. The completion will extend production a slight distance to the east.

Another test which is nearing the sand is Pan American 2 Guillory, now coring below 8,200 ft. On the west flank Texas 1-B Labanois Land & Stone Co. is drilling below 8,000 ft. This is the first deep test to be drilled in the area and it is scheduled to be drilled to a depth of 9,000 ft. or deeper.

Shallow Ritchie Field Defined Further

The limits of the shallow Ritchie field, Acadia Parish, were further defined with the abandonment of Bering Oil Co. 1 Ruppert at a total depth of 3,511 ft. Offsetting production to the west, W. N. Finnegan, Jr., announced location for 1 Raymond McManus located in 20-7s-1w. At a recent date six producers had been completed in the 3,500-ft. pay, having a daily initial production of 568 bbl.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: Fields	6	1,220	47,773
Dry holes: Fields	3	.....	20,560
Total	9	.....	68,333

Three Starts Announced at Bayou Sale Field

Drilling activity in the Bayou Sale field, St. Mary Parish, was being increased as locations for three wells were announced. Humble Oil & Refining Co. staked locations for 1 Miami Corp., and 2 Canal Bank & Trust Co. The former is located in 15-16s-9e, about 650 ft. from Cote Blanche Bay, while the latter is located in 16-16s-9e, about ¼ mile south of production. Midway between the discovery well and 1 Canal Bank & Trust Co., Harbor Oil Co. et al are moving in material for 1 State-Bayou Sale. About 1 mile south of production, mechanical trouble has delayed the completion of Atlantic 1 St. Mary Land Co. Total depth of the well is 11,877 ft., and casing was recently cemented after showings of oil and gas were logged in two new sands at 10,317-50 ft., and at 10,790-10,813 ft.

Two Wildcats Testing, Two Are Started

In the University field, East Baton Rouge Parish, Texas Progress Oil Co. 12 Nelson, a projected 10,000-ft. test, is preparing to drill plug after cementing a protection string of casing at 7,600 ft. This is the approximate depth of the regular field pay, and if no deeper sands are logged the hole will be plugged back and tested. Southeast of the field, the same company's 1 Nelson in 74-8s-1e, is drilling in sandy shale below 5,930 ft. The well is located on a block of approximately 5,000 acres which has been worked extensively with geophysical instruments.

Gulf 2 Miller estate, a projected 10,000-ft. test for the southwest flank of the Edgerly field, Calcasieu Parish, is preparing to drill deeper from 8,500 ft. where a string of protection casing was cemented. The first test drilled by the company in this area several months ago logged some interesting showings, but no succesful test was ever made due to mechanical trouble.

In the Moss Lake area, Calcasieu Parish, Union Oil Co. of California has spudded 1 Gray estate in 4-11s-9w. The well is situated northeast of a 10,000-ft. dry hole, recently drilled by Pan American Production Co. This area has been looked upon as a favorable prospect for a number of years, and several tests have been drilled in the general area.

Phillips 1 Louisiana Land & Exploration Co., the discovery well of the Bastian Bay field, Plaquemines Parish, is flowing at the rate of 56 bbl. of 41-gravity oil daily through ¼-in. choke. Tubing pressure was 2,800 lb. The well was recompleted in the discovery pay at 9,353-56 ft., after a series of tests up the hole showed gas and distillate.

LOUISIANA GULF COAST COMPLETIONS

Fields

Anse La Butte, St. Martin Parish: Stanolind 4 Rycade, 74 bbl., 9/64-in. choke, perf. casing 6,330-55 ft., T.D. 6,360 ft.

Chacahoula, La Fourche Parish: Sun 10 Dibert-Stark & Brown, 203 bbl., ⅛-in. choke, perf. casing 7,188-7,220 ft., T.D. 7,369 ft.

Darrow, Ascension Parish: Humble 39 Community, dry, T.D. 6,844 ft.

Erath, Vermilion Parish: Texas 1-B Henry, dry, T.D. 12,005 ft.

Jennings, Acadia Parish: Bering 1 Ruppert, dry, T.D. 3,511 ft.

Potash, Plaquemines Parish: Humble 54 Orleans Levee Board, 584 bbl., ¼-in. choke, perf. casing 8,380-85 ft., T.D. 8,477 ft.

Roanoke, Jefferson Davis Parish: Humble 1 C. N. Taylor, 162 bbl., ¼-in. choke, perf. casing 8,824-29 ft., T.D. 8,840 ft.

(Continued on Page 204)

Increased Drilling at San Joaquin Reflects Demand

By L. P. STOCKMAN

SAN FRANCISCO, Calif., Nov. 3—The demand for heavy crude oil incident to the consistent increase in fuel oil consumption is being reflected in several San Joaquin Valley fields although drilling up to the present has been restricted to the more productive fields and especially those producing from the Vedder sand of Miocene age. Increased drilling has been quite noticeable during the past few months in the Kern River, Midway-Sunset, Mount Poso, and Round Mountain fields and a recent check indicates additional drilling will be undertaken in each of these fields during the next several months.

In addition to this development work, much of which is being done by major marketers, there has been a marked tendency to open up some of the heavy crude oil production that has ben shut in for a number of years. Many of these old wells, however, will require some reworking before they will be able to produce commercially. In some cases engines, pumps, rods and tubing have been removed and utilized elsewhere. The present amount of drilling under way in heavy crude oil fields is but a small part of what would be done if the price for heavy crude oil was higher.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: San Joaquin Valley	5	3,258	23,335
Coastal district	1	1,515	9,473
Los Angeles Basin	6	3,280	26,001
Gas wells: Tupman	1	*11.8	5,250
Elwood	1	*1.0	6,391
Dry holes: Fields	1	.....	10,101
Wildcats	6	.....	26,714
Total	21	.....	107,265

*Million cu. ft.

Outstanding Wildcats Are Abandoned; Honolulu Deep Test to Be Given Up

Wildcat mortality was quite high in the San Joaquin Valley area last week as several promising wildcats failed to find production and were abandoned. In the Kerman district which appeared to have excellent prospects, Sam B. Herndon has abandoned 1 Bottoms in 3-14s-16e at 5,571 ft. in Cretaceous. This wildcat found top of the Big Blue at 4,045 ft., top of the Kreyenhagen at 4,859 ft. and top of the Eocene at 5,100 ft.

Shell Oil Co. marked off two wildcats this week as unproductive. In the Chowchilla district of Madera County, Shell abandoned 74-9 Chowchilla Farms after reaching the basement schist at 9,062 ft. This wildcat failed to show anything resembling an oil sand and its abandonment was not surprising.

In the Delano district of Kern County, Shell reached the basement schist at 6,339 ft. in 52-21 Bell, 21-25s-26e, and the hole has been abandoned. The next several weeks should see the abandonment of Honolulu's deep test in the Buena Vista Hills section of the Midway-Sunset field as this well has been tested by stages on the way out and has failed to show any commercial production. Honolulu did a splendid job of drilling on this deep test, which was bottomed at 14,622 ft., but the grease just was not present.

Northeast and Southeast Coalinga Nearly Connected

Drilling operations in the Northeast and Southeast Coalinga fields is nearing completion although Standard Oil Co. still has a number of locations to drill in the area between the two fields. Standard is gradually reducing the unproductive area between the southern end of the Northeast Coalinga field and the northern end of the Southeast Coalinga field and it will not be long before wells will be spaced at regular intervals along this interval.

Drilling operations during the past year have tended to indicate that these two fields would form one large productive district instead of two separate pools. For a long time there was an interval of 1 mile between the two fields but Standard has been reducing this area consistently for several months. It is not easy to correlate wells in these two districts although Standard Oil Co.'s field department has been proceeding for several months on the assumption that there will not be any production break between them. This company is in the best position to judge structural conditions and contours tend to run in accordance with expectations so far.

SAN JOAQUIN VALLEY COMPLETIONS

Chowchilla Wildcat District, Madera County: Shell 74-9 Chowchilla Farms, 9-11s-14e, abandoned at 9,062 ft., bottomed in basement schist 9,045-62 ft., no oil sand found.

Coles Levee, Kern County: Union 56-2 Kern County Land, 2-31s-25e, abandoned at 10,101 ft., swabbed salt water 9,895-10,101 ft., injected gas and swabbed salt water 9,593-865 ft., P.B. 9,390 ft. and abandoned, bottomed in gray sand.

Delano, Kern County: Shell 52-21 Bell, 21-25s-26e, abandoned at 6,339 ft., bottomed in basement schist, Vedder and Eocene sands were barren.

Helm, Fresno County: Amerada Pet. Corp. 31-34 Clover, 34-16s-17e, flowed 260 bbl., 65-gravity 0.1 per cent cut, 3,845,000 cu. ft. gas, 60/64-in. bean, pressures 2,000/100 lb., T.D. 10,257 ft., P.B. 7.440 ft.. perf. 7,300-10 ft., completed in upper zone of Miocene age, lower zone of Miocene age and productive zone in formation of Eocene age shut in behind plug at 7,440 ft.

Kerman Wildcat District, Kern County: S. B. Herndon 1 Bottoms, 3-14s-16e, abandoned at 5,571 ft., top Big Blue 4,045 ft., Kreyenhagen 4,859-83 ft., Eocene 5,100 ft., bottomed in Cretaceous shale, all sands barren.

Midway-Sunset, Kern County: Standard 105-27-B Fee, 27-31s-23e, pumped 143 bbl., 26.9-gravity, 2.6 per cent cut, 109,000 cu. ft. gas, T.D. 3,050 ft., 60 mesh perf. 2,563-3,044 ft., completed in C zone of Etchegoin formation.

Mount Poso, Kern County: Shell 32 Security, 16-27s-28e, pumped 155 bbl., 15.2-gravity, 30 per cent cut, T.D. 2,040 ft., perf. 1,977-2,040 ft., completed in Vedder zone 1,974-2,040 ft. of Miocene age.

Round Mountain, Kern County: Crestmont Oil Co. 8 Staley, 8-28s-29e, pumped 200 bbl., 16.1-gravity, 0.2 per cent cut, T.D. 1,610 ft., 80 mesh perf. 1,569-610 ft., completed in Vedder zone 1,578-610 ft. of Miocene age.

Round Mountain Wildcat District, Kern County: Pongratz, J. J. 1 Round Mountain, 2-28s-28e, abandoned as unproductive, T.D. 1,996 ft., cored 2 ft. of oil sand in Vedder zone at 1,844-46 ft., but not enough to produce, bottomed in gray sand.

Rumsey Hills Wildcat District, Yolo County: Standard 1-1 Tippetts, 15-12n-3w, abandoned at 2,490 ft., flowed salt water on production test.

Tupman, Kern County: Richfield 1-28-G Kern County Land, 28-30s-25e, flowed 11,800,000 cu. ft. gas, 3/64-in. bean, flow pressure 1,980 lb., T.D. 5,250 ft., perf. 5,149-241 ft., completed in gas zone overlying Stevens oil zone.

Richfield 27-27-B Kern County Land, 27-30s-25e, flowed 2,500 bbl., 34.5-gravity, 0.2 per cent cut, 3,150,000 cu. ft. gas, two 1½-in. beans, pressures 400/1,400 lb., T.D. 9,195 ft., perf. 8,954-9,182 ft., completed in Stevens zone of Miocene age.

SAN JOAQUIN VALLEY OUTPOSTS

Belridge, Kern County: Belridge Oil Co. 55-26 Fee, 26-27s-20e, drilling and coring 10,830 ft. in hard sand, testing, top Eocene 9,545 ft., now below Wagonwheel of Eocene age, elev. 658 ft.

Buena Vista Hills, Kern County: Honolulu 25-P Fee, 10-32s-24e, T.D. 14,622 ft., P.B. 11,059 ft., perf 4,650-4,850 ft., 5,300-5,400 ft., preparing to abandon. elev. 916 ft.

Standard 91-11-D Fee, 11-32s-24e, drilling 961 ft. in sand.

Canal, Kern County: Shell 44-14-A Kern County Land, 14-30s-25e, drilling in oil sand and shale 10,698 ft., first Vedder zone test in field, 9⅝-in. casing cemented 9,680 ft., elev. 325 ft.

Dyer Creek, Kern County: Shell 2 Smith-Cairns, 11-26s-27e, drilling 288 ft. in sand.

Elk Hills, Kern County: Standard 24-19-R Fee, 19-30s-23e, drilling 3,681 ft. in shale.

Standard 62-31-S Fee, 31-30s-24e, drilling 5,600 ft. in sand and shale, elev. 1,220 ft.

Standard 45-19-S fee, 19-30s-24e, drilling 11,171 ft. in sand and shale, will be deep test, elev. 707 ft.

Greeley South, Kern County: Macrate, A. N., 1 Haberfeld, 32-29s-26e, drilling 10,960 ft. in sand and very hard shale, top barren Stevens zone of Miocene age 8,090 ft., looking for Vedder, elev. 338 ft.

Kern Front, Kern County: Richfield 1 Kraemer, 34-28s-27e, drilling 6,398 ft. in sand, looking for Vedder zone of Miocene age.

Kettleman North Dome, Kings County: Standard 1-1-U Fee, 1-23s-18e, T.D. 12,884 ft. in hard gray sand showing considerable gas, redrilled 11,640 ft., tested wet, P.B. 8,555 ft., lower part of hole abandoned, elev. 693 ft.

Midway-Sunset, Kern County: North Amer. Oil Cons'd. 1-28 W.P., 28-32s-23e, drilling 10,080 ft. in sandy shale, elev. 1,560 ft.

Mountain View, Kern County: Hogan Pet. Co. 1-A Bahrenburg, 32-30s-29e, drilling and coring 6,592 ft. in sand and shale, will be deep test for Vedder zone.

Mount Poso, Kern County: Bishop, Bradford 1 Poso, 22-27s-28e, T.D. 1,434 ft. in oil sand and shale, will cement casing and test.

Paloma, Kern County: Western Gulf 12-7 Symons, 7-32s-27e, drilling 11,230 ft. in Pliocene sand, most easterly well in field, log shows 50 ft. of oil sand 10,850 ft., elev. 299 ft.

Raisin City, Fresno County: Bandini Pet. 82-23 S.P., 23-15s-17e, drilling in sand and shale 5,503 ft.

Barnsdall 71-23 Ripperdan, 24-15s-17e, location staked.

Shell 31-19 S.A.F.L., 19-15s-18e, rigging up rotary drilling equipment.

Rio Bravo, Kern County: Union 21-33 Pacific States, 33-28s-26e, T.D. 13,642 ft. in Eocene sand below Vedder zone of Miocene age, P.B. 11,505 ft. in Rio Bravo and Vedder zones, elev. 330 ft.

Union Avenue, Kern County: Hancock Oil Co. 3 Roberts, 6-30s-28e, preparing to spud.

SAN JOAQUIN VALLEY WILDCATS

Altamont District, Alameda County: Shell 1 Nissen, 7-2s-3e, T.D. 5,888 ft., lost fish, P.B. 5,665 ft., redrilled to 5,708 ft., went into old hole, stuck whipstock 4,356 ft., fishing, elev. 1,023 ft.

Belridge District, Kern County: Parkford, E. A., 1 Belridge, 12-29s-21e, drilling 1,138 ft. in sand and shale, cemented 8⅝-in. casing 925 ft., elev. 563 ft.

Helm District, Fresno County: General Pet. Corp. 75-33 Esperoad, 33-16s-17e, location along east line of section.

McDonald Anticline District, Kern County: Texas 1 Anderson, 19-28s-20e, drilling 5,270 ft. in sand and shale, elev. 1,080 ft.

Rio Vista District, Solano County: Standard 1 Bradford, 20-3n-3e, T.D. 4,350 ft. in gas sand, P.B. 4,226 ft., perf. 4,160-223 ft., testing, elev. 5 ft.

Standard 1 Productive Properties, 23-3n-3e, drilling 5,373 ft. in sandy shale, elev. 5 ft.

Standard 2 Midland Fee, 3-3n-3e, drilling 3,774 ft., Emigh shale 3,625 ft., elev. 16 ft.

Amerada 1 Robinson, 4-4n-2e, drilling 5,745 ft. in sand.

Riverdale District, Fresno County: Amerada 45-26 Lawton, 26-17s-19e, drilling 182 ft. in sand.

Shafter District, Kern County: General Pet. 51-15 S.P., 15-28s-24e, drilling 11,451 ft. in sand and hard cherty shale.

Shale Hills District, Kern County: Morton, H. C., 1 Core Hole, 30-26s-19e, T.D. 2,205 ft. in shale and oil sand, P.B. 1,000 ft., pumped little fluid, will swab.

Tideland Oil Co. 1 Grant, 4-27s-18e, drilling 732 ft. in sand and shale.

AVERAGE DAILY PRODUCTION

	Nov. 1	Oct. 25
Wilmington	86,950	86,375
Midway-Sunset	42,950	44,000
Coalinga	38,375	40,550
Ventura Avenue	38,250	39,550
Long Beach	37,750	37,550
Kettleman North Dome	36,975	39,700
Huntington Beach	27,975	28,850
Dominguez	23,195	24,725
Santa Fe Springs	22,350	22,200
Santa Maria Valley	19,275	19,125

Wells Killed by Earthquake May Be Redrilled

R. E. Havenstrite and Union Oil Co. apparently have a major problem on their hands as a result of the earthquake late in October which killed nine flowing wells in the Dominguez field as all may have to be redrilled. Union has run tubing feelers in some of its wells and has found the tubing pinched around 6,000 ft. Further investigation is under way and the true condition of the wells affected should be determined within another several days. This is the largest number of wells affected at any one time as a result of an earthquake although these periodic shakes may be responsible to some extent for the bad casings that have developed in the Dominguez field in the past.

Havenstrite lost four out of six producing wells on the Larronde lease and the wells that were killed were the best producers on the property. So far there has not been any increase in oil or gas production in wells located to the north and northwest which is rather surprising as this tends to indicate that the gas volume is remaining in place and not moving down structure toward the area of low pressure. Altogether 14 wells in the Dominguez field were affected by the earthquake of October 21 but not all wells affected were killed.

Seasonal Decline in Drilling Has Started

Along about this time of the year, California operators usually reduce drilling operations and again this year a tendency along this line is quite marked. The reason for this is that usually by early November the amount budgeted for drilling has been exhausted during the preceding 10 months and drilling departments find it necessary to secure additional appropriations to carry drilling operations over the final 2 months.

There has been a pronounced decline in drilling operations during the past month and this condition is expected to continue throughout the remainder of the

current year. Wilmington is the only field in Los Angeles Basin that continues to show consistent development and this field likewise heads the entire list from a drilling standpoint.

With the exception of discoveries and a few fields in the ascendancy there are not any too many locations available for future work in flush fields. Greeley is rapidly nearing completion of its drilling program as far as the northern end of the field is concerned and Rio Bravo operators have been drilling around the edge of the field for several months. The same situation prevails in Los Angeles Basin fields although operators holding potentially productive acreage in the Inglewood field will be able to proceed with deep Miocene drilling for several months after they begin aggressive development. So far there has been no disposition to undertake aggressive deep zone exploitation.

LOS ANGELES BASIN COMPLETIONS

Huntington Beach, Orange County: Signal O. & G. Co. 31 Bolsa, 33-5s-11w, pumped 499 bbl., 29.2-gravity, 0.2 per cent cut, T.D. 3,411 ft., perf. 2,840-3,090 ft., completed in Bolsa zone of Pliocene age.

Inglewood, Los Angeles County: Standard 2-12 Vickers, 7-2s-14w, flowed 2,246 bbl., 28.9-gravity, 1 per cent cut, 2,134,000 cu. ft. gas, 20/64-in. tubing bean, 18/64-in. casing bean, pressures 600/700 lb., T.D. 8,300 ft., perf. 7,983-8,298 ft., completed in Sentous zone of Miocene age, Nodular shale 7,740 ft.

Long Beach, Los Angeles County: Apex Pet. Corp. 38 Grimm, 29-4s-12w, pumped 25 bbl., 23.9-gravity, 60 per cent cut, T.D. 6,024 ft., reperf. 2,943-4,358 ft., recompleted in Alamitos zone of Pliocene age.

Puente Wildcat District, Los Angeles County: Altchuler, L. J., 1 Larry, 30-2s-9w, abandoned at 1,256 ft., small oil showing at 1,115 ft., but not commercially productive.

Rosecrans, Los Angeles County: Universal Consolidated 2 Trust, 18-3s-13w, flowed 304 bbl., 29.6-gravity, 0.7 per cent cut, 400,000 cu. ft. gas 128/64-in. bean, T.D. 8,183 ft., perf. 7,860-8,162 ft., deepened from 7,601 ft. to lower O'Dea zone of Miocene age.

Wilmington, Los Angeles County: Bolling Oil Co. 6 Harbor, 32-4s-13w, pumped 65 bbl. 16.1-gravity, 20 per cent cut, T.D. 3,720 ft., perf. at intervals 3,020-720 ft., completed in Ranger zone.

De Marsh Oil Co. 1 Harbor, 2-5s-13w, pumped 75 bbl., 16.2-gravity, 3 per cent cut, T.D. 3.120 ft., perf. 2,818-3,120 ft., completed in Ranger zone.

M. A. K. Pet. Corp. 6 Harbor, 32-5s-13w, pumper 255 bbl., 16-gravity, 12 per cent cut, T.D. 3,750 ft., 80 mesh perf. 3,500-750 ft., 100 mesh perf. 3,057-330 ft., completed in Ranger zone.

Wilforth Oil Co. 3 Harbor, 29-4s-13w, pumped 140 bbl., 14.5-gravity, 3 per cent cut, T.D. 3,700 ft., perf. 2,998-3,120 ft., 3,189-281 ft., 3,469-700 ft., completed in Ranger zone.

LOS ANGELES BASIN OUTPOSTS OR DEEP TESTS

Dominguez, Los Angeles County: Decker and Associates, 1 Frome, 29-3s-13w, T.D. 7,268 ft. in oil sand, 7-in. casing cemented 7,247 ft.

Inglewood, Los Angeles County: Federal Oil Co. 2 Smith, 7-2s-14w, T.D. 8,292 ft., swabbing for production.

Hogan Pet. Co. 3-A Machado, 7-2s-14w, drilling 8,305 ft. in oil sand and shale, completing.

Jefferson Oil Co. 2 Smith, 7-2s-14w, erected derrick.

Texas 8 Smith, 7-2s-14w, T.D. 8,412 ft. in oil sand, top Nodular 7,840 ft., redrilled 6,730 ft., ran into old hole, backed up, now redrilling 6,558 ft., elev. 242 ft.

Tide Water Associated 71 Vickers, 7-2s-14w, foundation.

Tide Water Associated 72 Vickers, 7-2s-14w, drilling 6,060 ft. in sand and shale, elev. 350 ft.

Potrero, Los Angeles County: Tide Water Associated 5 Cypress, 34-2s-14w, rigged up.

Torrance, Los Angeles County: Jergins Oil Co. 1 Dominguez, 5-4s-14w, drilling 3,657 ft. in shale and oil sand, is running higher than previous wells in area, pumping oily, gassy mud to sump.

LOS ANGELES BASIN WILDCATS

Buena Park District, Orange County: Texas 1 Spencer, 1-4s-11w, rig erected, hauling in equipment.

Costa Mesa District, Orange County: Thompson, M. N., 1 Banning, 9-6s-10w, T.D. 5,645 ft., redrilled to 4,220 ft., cleaning out sand bridges.

Huntington Beach District, Orange County: La Bolsa Rancho Syndicate, 1 La Bolsa, 22-5s-11w, rigged up.

Palos Verdes District, Los Angeles County: Newton Dev. Co. 1 P.V., 13-5s-15w, T.D. 3,970 ft. in schist basement, will abandon.

Puente District, Orange County: Sunset Oil Co. 1 Baldwin, 11-2s-11w, T.D. 4,681 ft. in hard gray sand and black shale with streaks of conglomerate and oil sand, top Kraemer shale 3,888 ft., will gun perf. 3,830-50 ft. and test.

Kosanke, J. F., 1 Puente, 24-2s-10w, T.D. 1,823 ft. in sand and shale, swabbed water with scum of oil.

Rio Hondo District, Los Angeles County: Potrero Oil Co. 1 Newman, 32-1s-11w, rigged up, located one mile north of eastern tip of Montebello field.

Seal Beach, Orange County: South Basin Oil Co. 1 Heller, 6-5s-11w, drilling 8,014 ft. in Pliocene sand and shale, top Alamitos shale 5,875 ft., Brown shale 6,910 ft., will abandon, joint test of South Basin Oil Co., Johnston Drlg. Co. and Allied Pet. Co.

Whittier District, Los Angeles County: Los Nietos Valley Oil Co. 1 Los Nietos, 29-2s-11w, drilling 125 ft. in sand.

Union 13 Sansinena, 30-2s-10w, drilling 101 ft. in shale and sand.

Production From Deep Zone At Rincon Is Disappointing

Chanslor Canfield Midway's 3-C Hobson failed to change the status of the deep zone in the Rincon field of Ventura County this week although the lower part of the hole was not open to production. This well began flowing while the crew was running in tubing and while it came in flowing at the rate of 20 bbl. per hour the well is now flowing about 100 bbl. per day by heads. The crew had 2,800 ft. of tubing in the hole when it began to flow. The interval open to production was at 9,048-10,080 ft. but this 1,032 ft. of oil sand was too tight and lacked sufficient porosity and permeability to make a good well. This deep test is bottomed at 10,515 ft. but the lower 435 ft. of the zone has not been tested out. This section looks a little better than that tested out higher up in the hole but it too appears too tight to show large production. No. 3-C Hobson is the deepest hole drilled in the Rincon field to date and it will therefore retard any further deep drilling unless the lower part of the hole proves more productive than the upper 1,032 ft.

Operations High in Newhall-Potrero Group

The Newhall-Potrero group, which includes among others the Aliso Canyon, Oak Canyon and Del Valle fields, has been showing a consistent increase in drilling and a number of completions should be recorded during the next 30 days. In the Del Valle field, R. E. Havenstrite has four wells under way and Bankline, Ohio, and Standard are working on one well each. In the Newhall-Potrero field, Barnsdall Oil Co. is drilling two wells and has derricks standing for two more and in the Aliso Canyon field, Tide Water Associated has one string of tools in operation and rigs standing for three more.

In the Oak Canyon field, discovered by Western Gulf Oil Co. a few months ago, Western Gulf is making hole in 1 Wickham and Hathaway Co. is drilling ahead in 1 Ram, both wells being located in 31-5n-17w. During the next several weeks a number of wells will be started in the interval between the Havenstrite section of the Del Valle field in the east end of the structure and the Videgain area which is located at the far west-

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ern end of the field. These two productive sections on the Del Valle anticline are almost 1 mile apart but the intervening area is expected to be found productive.

Wildcat East of Aliso Canyon
Nearing 5,800 Ft.

A little less than 1 mile east of the Aliso Canyon field, Tide Water Associated Oil Co. is nearing 5,800 ft. in a wildcat drilled on the Mission property in 26-3n-16w but still has some distance to go before reaching its objective. This well has been drilling through the usual hard formations present in this area and consequently progress has been rather slow.

East of this well, Shell Oil Co. is grading roads to location for its 2-1 Mission which will be drilled in 25-3n-16w. The wildcat of Tide Water Associated is about 1 mile east of the Aliso Canyon field and Shell's location is in the next section to the east. The elevation of these wells indicates the rough topography of the area as Associated's 1 Mission has an elevation of 2,709 ft. and Shell's Mission wildcat has an elevation of 1,600 ft. In Towsley Canyon, 1 Limbocker a joint wildcat of Barnsdall Oil Co., Bandini Petroleum Co. and Ambassador Petroleum Co. has reached a depth of 3,750 ft. and is going ahead in a hard shale.

COASTAL DISTRICT COMPLETIONS

Elwood, Santa Barbara County: Barnsdall 88-11 State, 15-4n-29w, flowed 1,000,000 cu. ft. gas, 7/64-in. bean, pressure 800/1,050 lb., T.D. 6,391 ft., perf. 5,360-410 ft., 5,411-40 ft., 5,441-80 ft., completed in Sespe formation of lower Miocene age.

Ventura Avenue, Ventura County: Shell 37 Edison, 21-3n-23w, flowed 1,515 bbl., 29.4-gravity, 3 per cent cut, 910,000 cu. ft. gas, 128/64-in. bean, pressure 100/150 lb. T.D. 9,473 ft., perf. 8,700-970 ft., 8,991-9,267 ft., 9,301-428 ft., completed in 57 zone of Pliocene age.

Shell 109 Taylor, 29-3n-23w, flowed gas lift 245 bbl., 25.8-gravity, 21 per cent cut, T.D. 7,394 ft., perf. 5,795-870 ft., 5,880-970 ft., 6,010-115 ft., 6,140-260 ft., 6,300-420 ft., 6,470-610 ft., 6,630-720 ft., 6,730-977 ft., 7,202-391 ft., recompleted on gas lift from interval 5,795-7,391 ft. of Pliocene age.

COASTAL DISTRICT WILDCATS

Aliso Canyon District, Los Angeles County: Associated 1 Mission, 26-3n-16w, T.D. 5,751 ft. in gray sand, reaming, elev. 2,709 ft.

Shell 2 Mission, 25-3n-16w, bldg. rig.

Castaic District, Los Angeles County: Texas 1 Fernando, 11-4s-17w, drilling 2,284 ft. in sand and shale, elev. 1,251 ft.

Cat Canyon District, Santa Barbara County: Bell, A. E., 1 Gilmore, 23-9n-33w, T.D. 6,180 ft., 7-in. casing cemented 4,930 ft., deepening after swabbing 150 bbl. daily, would not flow.

Standard 3 Los Flores, 27-9n-33w, drilling in sand and sticky shale 5,698 ft., elev. 1,065 ft.

Union 12 Bell, 27-9n-33w, rig, is offset to Standard's 2 Los Flores.

Union 13 Bell, 27-9n-33w, preparing to spud.

Camulos Ranch, Ventura County: Western Gulf 1 Rubel, 22-4n-18w, T.D. 7,096 ft., will abandon, elev. 750 ft.

Del Valle District, Los Angeles County: Bankline Oil Co. 1 Videgain, 17-4n-17w, T.D. 7,700 ft. in shale and oil sand, top Miocene 5,856 ft., P.B. 6,160 ft., elev. 1,719 ft.

Loma Grande District, Monterey County: Loma Grande Oil Co. 1 Corey, 23-24s-10e, T.D. 3,575 ft. in shale, sidetracked fish and cemented 6⅝-in. casing 3,575 ft., elev. 1,500 ft.

Newhall District, Los Angeles County: Aztec Oil Co. 1 Sanborn, 6-3n-16w, T.D. 6,113 ft. in Miocene oil sand and sandy shale, swabbed dry, may deepen, elev. 1,516 ft.

Young, R. W., 1 Walker, 11-4n-16w, drilling 5,481 ft. in hard gray sand and hard siltstone, had oil and gas shows on ditch, top Miocene 5,078 ft., elev. 1,254 ft.

Towsley Canyon District, Los Angeles County: Barnsdall & Ambassador Pet. 1 Limebocker, 17-3n-18w, drilling 3,782 ft. in hard sand and shale, elev. 1,680 ft.

Louisiana Gulf Coast Fields

(Continued from Page 201)

Welsh, Jefferson Davis Parish: Union Sulphur 1 Arceneaux, 146 bbl., 9/64-in. choke, perf. casing 7,432-40 ft., T.D. 7,509 ft.

Westwego, Jefferson Parish: Stanolind 1 Weigand, 59 bbl. oil, plus 29 per cent salt water, 3/32-in. choke, perf. casing 8,984-88 ft.

LOUISIANA GULF COAST DRILLING REPORT

Acadia Parish: Stanolind 1 Tweedel, 77-7s-3e, drilling shale 7,896 ft.

Calcasieu Parish: Union Oil Co. of Calif. 1 Gray, 4-11s-9w, rigging up.

Cameron Parish: Superior 1 Paggi, Lakeside field, drilling shale and lime 9,264 ft.

East Baton Rouge Parish: Texas Progress 1 Nelson, 74-8s-1e, drilling sandy shale 5,930 ft.

Iberia Parish: Gulf 2 Pettit Anse Co., 25-13s-5e, drilling sand 10,158 ft.

Jefferson Davis Parish: Cities Service 1 Lacassine, 36-11s-5w, derrick.

Rapides Parish: M. H. Marr 1 Eota Realty Co., 14-4n-3e, T.D. 7,068 ft., cutting side-wall cores.

St. Martin Parish: Amerada 1 St. Martin Land Co., T.D. 6,490 ft., milling on junk.

St. Mary Parish: Texas 1 State Cote Blanche Co., Twp. 15s-7e, T.D. 8,129 ft., running electrical log.

Nacatoch Sand Pay Opened Southeast of Buffalo Area

By R. MARNE SANFORD

SHREVEPORT, La., Nov. 3.—About 4½ miles east and slightly south of the old Buffalo area or East Stephens field a new producing spot has been opened by an estimated 150-bbl. well from the Nacatoch sand at the 1,616 ft. level.

The discovery well is Bergman 2 Cook, located in NW SW 27-15n-18w, Ouachita County. The strike is between the old Buffalo area and a small productive spot just to the west of the old Smackover field. It definitely opens a new area for development from the prolific Nacatoch sand found throughout this district. Unable to sustain a natural flow from the well, operators were rigging up pumping unit at the close of the week.

The Buffalo area was developed at about the time of the Stephens field and embraced originally some 20 wells, several of which are now abandoned. The Buffalo area itself is about 2 miles east of the original Stephens field and is just north and east of the town of Stephens. Little possibility of a link between the two areas is expected, however, due to the fact that there are several dry holes in the intervening area which have tested formations deeper than the Nacatoch sand.

If commercial production is finally established, an immediate drilling program is likely to result since the 1,616-ft. depth of the discovery well is not at all prohibitive to rapid development. Further exploration to the Nacatoch sand is planned to the northeast of this discovery for several miles. Foster and associates are planning to spud 1 Miller, 6 miles northeast and in SW SW 4-15n-18w, in Ouachita County.

Indicated Union County Deep Discovery Gets Water

Early in the week high hopes were held for a deep Smackover lime wildcat in Union County. However hopes were dampened at the close of the week. The wildcat is Atlantic Refining Co. 1 Davis unit, NE NW 15-17s-18w. It topped the Buckner at 7,026 ft., the Smackover lime at 7,137 ft., and found first porosity at 7,148 ft. A core from 7,150-60 ft. recovered 9½ ft. of oolitic lime showing porosity and oil saturation with strong gas odor. Contemplations were toward running casing for a production test. In taking a few more feet of saturation, water was topped at 7,177 ft. and at last reports the test was drilling deeper below 7,205 ft. It will probably entirely penetrate the zone, likely finding more thin sections or saturation, then successively plug back for tests of each zone.

Second Well Completed at East Schuler Field

The second oil producer has been completed in the new East Schuler field of Union County. It is Atlantic Refining Co. 1 Briggs, SW SW 13-18s-17w, and extends the field ½ mile to the southwest, the discovery well having been Crecent Drilling Co. 1 Burns. The new well flowed 336 bbl. of oil daily from perforations in casing from 5,658-62 ft., total depth 5,785 ft.

ARKANSAS COMPLETIONS

Wildcats

Lafayette County: Tide Water-Seaboard 1 Moore, SW SE 29-17s-24w, top Arkadelphia 1,620 ft., Nacatoch 1,820 ft., Saratoga 2,216 ft., Tokio 2,900 ft., Annona 2,557 ft., Paluxy 3,410 ft., massive anhydrite 4,880 ft., James 5,360 ft., Buckner 9,110 ft., Smackover 9,262 ft., flowed 215 bbl. distillate, 48 gravity, and 55 bbl. water daily, perf. casing 9,312-40 ft., tubing pressure 1,200 lb., casing pressure 2,000 lb., gas-oil ratio 4,400/1.

Prairie County: Alvin E. Stark 1 Fidelity Mutual Insurance Co., SW NE NE SW 16-2n-6w, dry at 1,350 ft.

Fields

Atlanta, Columbia County: Tide Water-Seaboard 3 Beene, SW NE 15-18s-19w, 487 bbl. oil, 8,200 ft., total depth.

East Schuler, Union County: Atlantic Refg. 1 Briggs, SW SW 13-18s-17w, 336 bbl. oil, perf. casing 5,658-62 ft., 5,785 ft., total depth.

El Dorado, Union County: Sam Sebersky 1 M. C. Wells, (O.W.D.D.), NE SW NE NE 19-18s-15w, dry at 2,805 ft.

Fouke, Miller County: Carter 2-B W. P. Sturgis, NW SE 2-17s-27w, 82 bbl. oil, perf. casing 3,631-40 ft., 3,750 ft., total depth.

Stephens, Columbia County: Crow Drlg. Co. 1-B E. C. Smart, NW SE NW 13-15s-20w, 175 bbl. oil and 25 bbl. water, 3,400 ft., total depth.

SUMMARY OF COMPLETIONS

North Louisiana

	No.	Bbl.	Footage
Oil wells: Bellevue	1	15	404
Caddo	4	715	6,520
Nebo	2	263	8,399
Gas wells: Monroe	2	*19.4	4,363
Dry holes: Wildcats	2	.....	11,190
Little Creek	1	.....	3,234
Nebo	2	.....	8,452
Olla	1	.....	2,906
Trout	1	.....	3,667
Total	16	.....	49,135

Arkansas

	No.	Bbl.	Footage
Oil wells: Wildcats	1	215	9,340
Atlanta	1	487	8,200
East Schuler	1	336	5,785
Fouke	1	82	3,750
Stephens	1	175	3,400
Urbana	2	450	6,213
Dry holes: Wildcats	1	.....	1,350
Total	8	.....	38,038
Recompletions: El Dorado	1	.....	.....
Smackover	1	.....	.....

East Texas Border

	No.	Bbl.	Footage
Dry: Wildcats	1	.....	3,663

*Million cu. ft.

Smackover, Ouachita County Gulf 7 Fincher,(O.W.D.D.), NE SW 28-15s-16w, dry at 2,548 ft.

Urbana, Union County: Marine Oil 7 Simmons, SE NW 10-18s-13w, 200 bbl. oil and 140 bbl. water, perf. casing 3,006-10 ft., T.D.

Marine Oil 6-A U.S.M., NW SE 3-18s-13w, 250 bbl. oil and 125 bbl. water, perf. casing 2,983-88 ft., 3,203 ft., total depth.

Test Between Larto Lake and Cypress Bayou Dry in Wilcox

The first failure has been reported for the large area undergoing exploration between the recently opened Larto Lake (Wilcox producing) field and the little developed Cypress Bayou field (formerly Walters). Carter Oil Co. abandoned as dry its 1-E Tensas Delta Land Co., between the two fields and located in NW NW 5-5n-4e. The test was quit at a total depth of 6,095 ft. after entirely penetrating the Wilcox section topped at 3,210 ft.

Another test in this area has defined production from the Wilcox section and is bottomed in deeper formations. It is Carter 1-G Tensas Delta Land Co., located in NE SW 30-6n-5e, 2 miles north of a new Wilcox level wildcat by Phillips and 3 miles south of the Cypress Bayou field. It is also 6 miles northwest of the Larto Lake discovery well, placing it almost exactly midway between the two fields. The 1-G Tensas is fishing for bit at total depth of 6,197 ft. after reporting the following tops of formations: Vicksburg 1,340 ft., Cockfield 1,750 ft., Cook Mountain 2,335 ft., Sparta 2,467 ft., Cane River 3,206 ft., Wilcox 3,331 ft., Midway 6,014 ft., and stains of oil from 2,515-33 ft., 2,548-58 ft., and 2,564-86 ft.

There are eight active tests within a radius of 7 miles from a point midway between the Larto Lake and Cypress Bayou fields. This means that although production is found almost twice as deep as northward in the Olla, Little Creek and Nebo fields, exploration still continues at just as intense a rate. Production in the Larto Lake field was found below the 6,000-ft. level and any further production in the area will likely approximate this depth.

NORTH LOUISIANA COMPLETIONS

Wildcats

Grant Parish: H. L. Hunt 5-F Goodpine, SW SE 22-8n-1w, dry at 5,095 ft., no tops available.

La Salle Parish: Carter Oil 1-E Tensas Delta Land Co., NW NW 5-5n-4e, top Wilcox 3,210 ft., dry at 6,095 ft.

Fields

Bellevue, Bossier Parish: Premier Investment Co. 64 Wyche, SE NW 14-19n-11w, 15 bbl. 404 ft., total depth.

Caddo, Caddo Parish: S. Reele 1 Langford Herndon, SE NW 22-21n-15w, 40 bbl., 1,605 ft., total depth.

Stanolind 143 Dillon, NE SW 13-21n-15w, flowed 539 bbl. daily, 1,665 ft., total depth.

W. E. Stewart 1 Atkin-Webb, NE SW 31-21n-15w, 25 bbl. daily, 1,575 ft., total depth.

Texas Co. 13 Mabry, NW SE 15-21n-15w, 111 bbl. oil and 20 bbl. water, 1,675 ft., total depth.

Little Creek, La Salle Parish: H. L. Hunt 101-F Goodpine SW SW 19-9n-9e, dry at 3,234 ft.

Monroe, Ouachita Parish: A. S. Huffman 1 Interstate fee, SE NW 23-19n-3e, 1,808,000 cu. ft. gas, 2,183 ft., total depth.

Monroe, Union Parish: Interstate Natural gas 113 fee, SW NE 24-20n-3e, 17,579,000 cu. ft. gas, 2,180 ft., total depth.

Nebo, La Salle Parish: Berkshire Oil 2 Ward, Lot 1, Sec. 40-7n-3e (irregular), 97 bbl. oil, perf. casing 3,662-65 ft., 4,050 ft., total depth.

H. L. Hunt 65-F Goodpine, SW NW 9-7n-3e, 166 bbl. oil and 19 bbl. water, perf. casing 3,852-55 ft., 4,349 ft., total depth.

H. L. Hunt 66-F Goodpine, SW SW 16-7n-3e, dry at 4,214 ft.

Patrick & Tyrell 1 Jones, SW NE 41-7n-3e (irregular), dry at 4,238 ft.

Olla, La Salle Parish: Placid Oil 11-C Tremont, SE NE 10-9n-2e, dry at 2,906 ft.

Trout, La Salle Parish: Scruggs & Todd 1 Grass, SW NE 19-8n-3e, dry at 3,667 ft.

NORTH LOUISIANA WILDCAT FIRST REPORTS

Catahoula Parish: S. H. Calvert 1 Tensas Delta Land Co., NE NW 36-7n-6e, location on geophysical high.

Phillips 1-F Tensas Delta Land Co., NE SW 21-6n-5e, location on geophysical high.

Lincoln Parish: Thomas Richardson 1 Jones, SW 8-18n-1w, 6,000-ft. test preparing to spud.

Winn Parish: H. L. Hunt 11-F Goodpine, SE NW 35-10n-3w, derrick on geophysical high.

H. L. Hunt 12-F Goodpine, NW NW 21-10n-1w, derrick on geophysical high.

H. L. Hunt 13-F Goodpine, NW NW 19-11n-3w, location on geophysical high.

AVERAGE DAILY PRODUCTION

NORTH LOUISIANA

	Nov. 1	Oct. 25
Caddo light	6,360	6,375
Caddo heavy	2,245	2,200
Cotton Valley	15,730	16,235
Cross Lake	2,650	2,685
De Soto and Red River	1,010	1,030
Haynesville	2,680	2,695
Homer	2,650	2,965
Lisbon	2,695	2,690
Little Creek	2,810	2,815
Nebo	4,465	4,300
Olla	13,725	13,740
Rodessa	13,705	13,695
Sligo	2,555	2,540
Sugar Creek	1,550	1,555
Urania	2,250	2,275
Zwolle	980	990
Total North Louisiana	80,750	81,295

SOUTH ARKANSAS

Atlanta	3,020	2,860
Buckner	2,320	2,335
Champagnolle	950	960
Dorcheat	1,750	1,750
El Dorado	1,425	1,450
Magnolia	18,910	18,950
Nick Springs	715	725
McKamie	2,325	2,315
Rodessa	1,170	1,165
Schuler	16,610	16,560
Smackover light	1,790	1,820
Smackover heavy	12,420	12,575
Troy	1,200	2,750
Urbana	2,950	2,750
Village	905	950
Total South Arkansas	72,375	71,945

MISSISSIPPI

Tinsley	62,735	65,960
Pickens	485	440
Total Mississippi	63,220	66,400

Shelby County Wildcat Finds Oil Shows in Pettit Lime

Interest was again centered on a wildcat test in Shelby County after oil shows had been found at a deeper level. It is Grady Vaughn 1 Frost, first thought to be a discovery well several weeks ago, but now being deepened. It is located in the James Buckley Survey just southwest of the town of Center.

A 34-ft. section in the Pettit lime was cored from 5,716 to 5,750 ft. which showed oil and gas saturation. The test was last reported shut down contemplating the setting of casing for production tests. The wildcat is southwest of the Joaquin-Logansport gas field on the Texas and Louisiana state line.

Marion County to Get Another Wildcat

During the past week Dean Bros. 1 fee, Weatherred Survey, Marion County, was abandoned as a failure after finding the Woodbine sand barren. Going ahead

(Continued on Page 214)

Shallow Sand Pool Opened in Union County, Kentucky

By STAFF CORRESPONDENT

OWENSBORO, Ky., Nov. 3.—A new pool was opened in Union County about 7 miles from other production and about 1 mile northeast of Spring Grove from a shallow Pennsylvanian age sand. Discovery well was Sun Oil Co. and Kentucky Natural Gas Co. 2 Reyburn, E½ SW 20-0-18, which was estimated as a 75-bbl. well from sand at 1,330-42 ft. The sand was identified tentatively as the Mansfield or the Jett and was cored from 1,320-42 ft. It showed best pay beginning at 1,330 ft.

Flush, before settling down, the well was swabbing about 7 bbl. of oil an hour, natural, with a spudding machine. At latest report the well was shut down awaiting the arrival of rods to install a pumping jack.

SUMMARY OF COMPLETIONS

Western Kentucky

	No.	Bbl.	Footage
Oil wells: Fields	1	400	1,631
Wildcats	1	75	1,342
Total	2	475	2,973

Eastern Kentucky

	No.	Bbl.	Footage
Gas wells	5	*1.1	12,299

Indiana

	No.	Bbl.	Footage
Oil wells	10	674	19,926
Dry holes	4	.....	4,103
Total	14	.....	24,029

Ohio

	No.	Bbl.	Footage
Oil wells	19	933	22,285
Gas wells	17	*30.3	44,195
Dry holes	16	.....	18,562
Total	52	.....	85,042
Input wells	6	.....	3,051
Recompletions	2	*5.8	.....

*Million cu. ft.

WESTERN KENTUCKY COMPLETIONS

Breckinridge County, Cloverport district: W. J. Flesher 1 W. E. Bowen, drilling at 50 ft.

Daviess County, Thurston district: Douthitt 2 C. H. Abell, drilling at 915 ft.

Hancock County, Skillman Station district: O. D. Vickers 1 William Hagman, spudding in.

McLean County, Southwest Livermore district: Ellis 8 Stevens heirs, 400 bbl., McClosky 1,626-31 ft.

Ohio County, Pleasant Ridge district: Massie & Wilkins 5 E. K. Moseley, rigging up.

Union County, Morganfield district: Sun Oil and Kentucky Natural Gas 2 J. W. Reyburn, 7 bbl. per hr., swabbing, Jett sand, T.D. 1,342 ft., *pool opener.*

Ohio Oil Co. 1 Briscoe, moving in.

Sun Oil and Kentucky Natural Gas 1 McKenney, rigging up.

Sun Oil and Kentucky Natural Gas 3 J. W. Reyburn, location.

EASTERN KENTUCKY

Floyd County: Kentucky-West Virginia 648 F. M. Rice, Hunts Fork of Prater Creek, 169,000 cu. ft. of gas at 2,585 ft.

Kentucky-West Virginia 5337 A. R. Music, Crooked Branch of Johns Creek, 56,000 cu. ft. of gas, shale, R.P. 280 lb., at 2,684 ft.

Martin County: Kentucky-West Virginia 5341 W. B. Preece, 434,000 cu. ft. gas, R.P. 425 lb., at 3,204 ft.

Knott County: Kentucky-West Virginia 5350 F. C. Akers, Right Beaver Creek, 249,000 cu. ft. gas, R.P. 283 lb., at 1,275 ft.

Johnson County: S. C. Allen and Crate Rice 1 Lottie Rice, Hurricane Branch of Barnetts Creek, 211,000 cu. ft. of gas, Corniferous and Big Six, shot, 2,251 ft.

Posey County Wildcat to Plug Back for Waltersburg Test

EVANSVILLE, Ind., Nov. 3.—Carter Oil 1 Maier, N½ NE SW 1-7s-14w, Posey County pool opener, failed to find saturation in the McClosky last week and will probably be plugged back to test showings of oil in the Waltersburg and Cypress. The test has been drilled to the top of the St. Louis. On a drill-stem test of the Cypress at 2,441-77 ft., 530 ft. of oil and 180 ft. of oil-cut mud were recovered. On a drill-stem test of Waltersburg saturation at 1,965-74 ft., the well flowed after 50 minutes. A light show of oil was also reported in the Aux Vases at 2,675 ft.

In Spencer County, Goldsmith 1 Swallow, SW SE SE 32-6s-7w, wildcat, ½ mile from production in the Enterprise pool, pumped 48 bbl. of fluid, of which 16 per cent was water, in 24 hours.

INDIANA COMPLETIONS

Wildcats

Blackford County: R. O. McKee 1 Godwin, NE SW SW 13-24n-11e, dry at 1,134 ft., Trenton 957 ft.

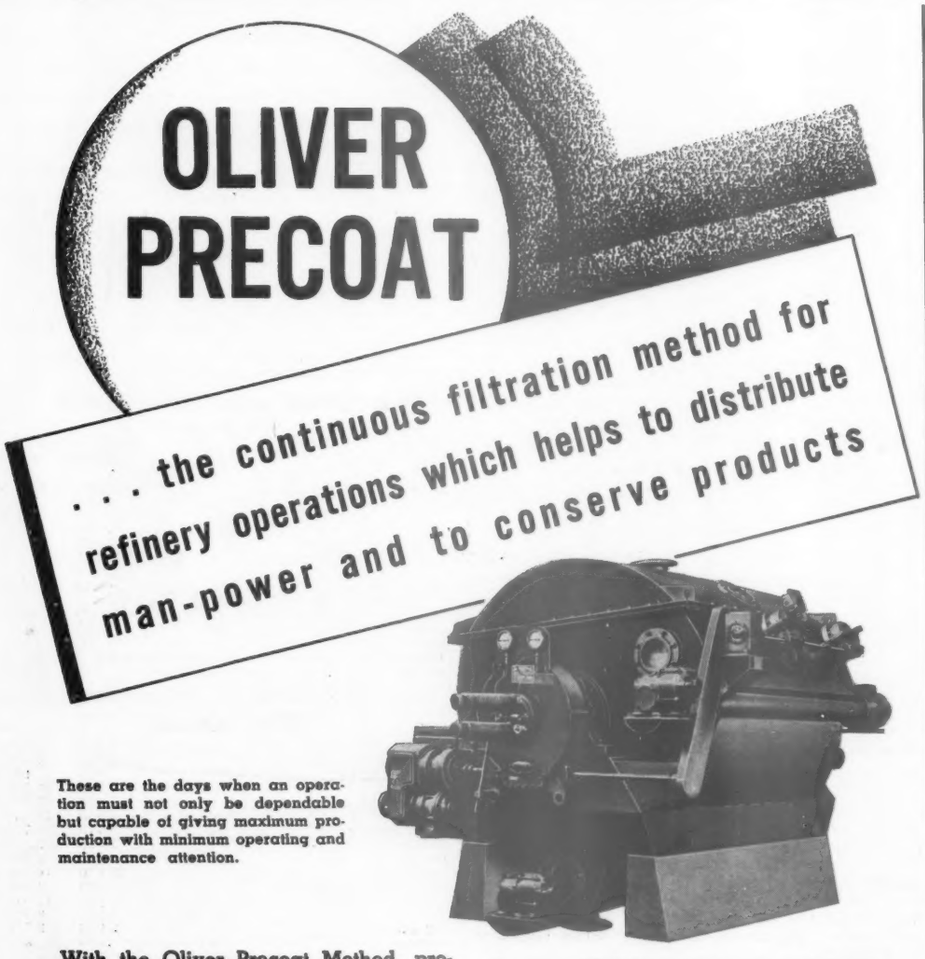
Elkhart County: Pet. Exploration 1 Woodard, S½ NE SW 25-38n-4e, dry at 560 ft., Devonian 555 ft.

Gibson County: Princeton Mining 1 Smith, SW NE SE 21-1s-12w, pumped 40 bbl., 10-qt. shot on bottom, T.D. 1,988 ft. *Mount Carmel extension.*

Jay County: Vickers et al 1 Keller, S½ N½ S½ 15-24n-14e, location abandoned.

Fields

Bufkin South, Posey County: Joe Dawson et al 1 Price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& Owens, NE NE NE 25-6s-13w, pumped 40 bbl., 20-qt. shot 1,128-34 ft., T.D. 1,148 ft.

Enterprise, Spencer County: E. J. Goldschmidt 1 Swallow, SE SE SE 32-6s-7w, pumped 10 bbl. oil and 30 bbl. water, natural, sand 985-91 ft., T.D. 991 ft.

Griffin, Gibson County: Continental 3 Kleiderer, SE NW 26-3s-14w, pumped 12 bbl. oil and 4 bbl. water, natural, Aux Vases 2,758-96 ft., T.D. 2,796 ft.

Continental 52 Bozeman, SW NW NW 26-3s-14w, pumped 5 bbl. oil and 22 bbl. water, 6-qt. shot 2,053-68 ft., T.D. 2,884 ft., P.B. 2,074 ft.

Hall-Edwards 45 Maier, NE SE SW 11-3s-14w, pumped 15 bbl. oil and 80 bbl. water, 40-qt. shot 2,528-46 ft., T.D. 2,557 ft.

Hazelton, Gibson County: Walter Miller et al 1 Kerr, NE SW NE 26-1n-10w, pumped 250 bbl., 500 gal. acid 1,739-42 ft., Ste. Genevieve 1,695 ft., T.D. 1,742 ft.

Heusler, Posey County: S. C. Yingling et al 1 Welborn, SW NE NE 1-7s-12w, pumped 112 bbl., 60-qt. shot 1,754-62 ft., T.D. 1,762 ft.

Heusler, Vanderburg County: T. W. Drake 2 Nurrenbern, S½ SE NE NE 6-7s-11w, pumped 35 bbl., 60-qt. shot 1,135-59 ft., T.D. 1,159 ft.

New Harmony, Posey County: Continental 15-A Kleiderer, SE NE 33-3s-14w, pumped 155 bbl., natural, pay 2,843-44½ ft., 2,847-49 ft., 2,887-90 ft., 2,892-99 ft., T.D. 2,899 ft.

Union, Pike County: Irwin & Powderly 1 McAtee, NW NW NW 33-1n-9w, dry at 1,059 ft.

Veale, Daviess County: George Chumos 1 McCain, NW SE NW 28-2n-7w, dry at 1,350 ft., dry sand 1,315-23 ft.

OHIO

NEWARK, Ohio, Nov. 3.—The Clinton play continues in the Ohio area. In the Clayton pool in Perry County producers with initial productions of 406, 238, and 177 bbl. were reported.

A 6,500,000-cu. ft. gasser in Medina County gives impetus to development southeast of Hinckley; other completions in this area include two gas wells and a dry hole. A test in Muskingum County was completed for 14,000,000 cu. ft. of gas.

A wildcat test 4 miles east of Dresden in Muskingum County was plugged after getting only a small gas showing in the Clinton.

Fair gas successes were reported in a number of the fields.

OHIO COMPLETIONS

Athens County

Lodi Township: Ross 1 Pearl Sapp, Sec. 13, 1½ bbl., Mitchell sand, T.D. 375 ft.

H. B. Walker 1 L. H. Blackwood, Sec. 1, dry, first Berea, T.D. 1,740 ft.

Rome Township: Chogulil et al 1 Fred Laughlin, Sec. 16, dry, Maxon (water), T.D. 980 ft.

Gallia County

Cheshire Township: C. A. Cody 1 David Mathews, Sec. 13, 85,000 cu. ft. gas, shot, second Berea, T.D. 1,705 ft.

Knox County

Jackson Township: Bell Bros. 3 L. McCament, Sec. 10, 30,000 cu. ft. gas, Berea, T.D. 885 ft.

Lawrence County

Union Township: Ohio Fuel 1 Garnet Ferguson, Sec. 8, 95,000 cu. ft. gas, shot, Ohio shales, T.D. 2,925 ft.

Licking County

Madison Township: Ohio Fuel 1 Emry Benton, Lot 8, second quarter, 1,330,000 cu. ft. gas, Clinton 2,473-2,504 ft., T.D. 2,508 ft.

Ohio Fuel 1 Homer Shaw, second quarter, dry, Clinton 2,592-2,620 ft., T.D. 2,641 ft.

Mary Ann Township: George Lacknette 1 Allen Maharg, 1,500,000 cu. ft. gas, Clinton 2,665-93 ft., T.D. 2,697 ft.

Newton Township: Ray Penick et al 4 Levi Lynn, fourth quarter, 500,000 cu. ft. gas, shot, Newburg 2,210-38 ft.

Perry Township: McClay Bros. 1 E. Clagget, Sec. 4, 30,000 cu. ft. gas, plugged, Clinton 2,950-3,005 ft., T.D. 3,037 ft.

Medina County

Chatham Township: Preston Oil Co. Special Account, F6 D. A. Clapp, Tract 15, Lot 10, 5 bbl., Berea, T.D. 522 ft.

Preston Oil Co. F03 D. A. Clapp, dry, Berea, T.D. 500 ft.

Preston Oil Co. G4 D. A. Clapp, 5 bbl., Berea, T.D. 496 ft.

Preston Oil Co. H4 D. A. Clapp, 5 bbl., Berea, T.D. 505 ft.

Preston Oil Co. H5 D. A. Clapp, 5 bbl., Berea, T.D. 515 ft.

Preston Oil Co. H05 D. A. Clapp, dry, Berea, T.D. 501 ft.

Preston Oil Co. J5 D. A. Clapp, dry, Berea, T.D. 526 ft.

Preston Oil Co. P6 D. A. Clapp, 5 bbl., Berea, T.D. 482 ft.

Preston Oil Co. CXL7 J. F. Grigsby, Tract 15, Lot 11, 5 bbl., Berea, T.D. 522 ft.

Preston Oil Co. F7 J. F. Grigsby, 5 bbl., Berea, T.D. 502 ft.

Preston Oil Co. G7 J. F. Grigsby, 5 bbl., Berea, T.D. 509 ft.

Preston Oil Co. K7 J. F. Grigsby, 5 bbl., Berea,

(Continued on Page 216)

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SOUTHWEST TEXAS

Washburn Outpost to Test Saturated Wilcox Sections

By F. L. SINGLETON

CORPUS CHRISTI, Tex., Nov. 3.—Main interest in the Southwest Texas district was centered on the Washburn field, La Salle County, where preparations were being made to test Quintana Petroleum Co. 1-B Washburn, about 1 mile southwest of the discovery well. While details are meager, casing is reported to have been cemented for testing following two drill-stem tests in approximately 58 ft. of saturated Wilcox sand, cored from 5,520-78 ft. The entire section of the Wilcox is said to have been drilled, but details as to what was found below 5,578 ft. were not available.

SUMMARY OF COMPLETIONS

Lower Gulf Coast District

	No.	Bbl.	Footage
Oil wells: Fields	10	1,210	58,526
Dry holes: Fields	5	.....	25,491
Total	15	.....	84,017

Laredo District

	No.	Bbl.	Footage
Oil wells: Fields	10	1,207	34,526
Dry holes: Fields	3	.....	9,358
Wildcats	6	.....	22,216
Total	19	.....	66,100

South Central Texas District

	No.	Bbl.	Footage
Oil wells: Fields	3	163	5,281
Dry holes: Fields	1	.....	3,610
Wildcats	3	.....	1,987
Total	7	.....	10,878

The discovery well of the field, Quintana 1 Washburn, topped the Wilcox at 3,612 ft., and was originally completed in August 1940 for a small producer at 5,417-22 ft. However, production soon declined and after a series of tests were made at intervals from 4,700-5,000 ft., the well was finally completed for a small producer at 5,416-23 ft. The completion of the well created wide attention, but subsequent development was disappointing and the field loomed as a minor discovery.

The field is located on what is believed to be one of the largest blocks ever assembled by an independent company, consisting of more than 18,000 acres extending through the northern half of the county. The completion of the well as a prolific producer would revive interest in this particular sector of the Wilcox trend. Most of this type of development has taken place several miles downdip, and with the exception of some distillate production being developed from the Carrizo sand in the West Tuleta field, Bee County, wildcatting has been disappointing. Only a limited amount of drilling has been done along the updip trend, but it now appears that this sector offers the best possibilities, and the area is due for considerable exploration.

Wildcat Started North of Cotulla Townsite

In the same county and located 6 miles northwest of the town of Cotulla, Humble Oil & Refining Co. started drilling operations on 1 J. E. Bishop, a projected deep test located in the A.C.H.&B. Survey 11. This company has done considerable geophysical work throughout the county and several thousands of acres have been taken under lease.

Oil Well Completed in La Reforma Gas Field

Two new producing oil areas were definitely established in Starr County. Porter & Pickens (J. L. Collins & Co.) 3 Guerra, located on the east side of the La Reforma gas field, converted this structure into an oil field when the well flowed 86 bbl. of 42-gravity oil in 6 hours through a 3/32-in. choke. Tubing pressure was 1,100 lb. Total depth of the well is 6,200 ft., and production is from the Frio-Vicksburg sand at 6,152-54 ft. While development of the structure has been limited, sufficient drilling has been done to establish it as a huge structure extending at the present time in a northeast-southwest direction for a distance of about 2 miles. Protection in the area is held by several major and independent companies and additional development is expected to be started in the near future.

In the extreme southern part of the county, and located about 4,100 ft. northwest of the discovery well of the Yturria field, Sun 5 Chapotal was completed for an initial production of 146 bbl. of 43.1-gravity oil daily flowing through a 9/64-in. choke. Tubing pressure was 575 lb., and casing pressure 925 lb. Total depth of the hole is 4,236 ft. with 5½-in. casing cemented at 4,235 ft. The discovery well was completed for a small producer from the same sand at 4,232-33 ft. Location for a third well, about 1,100 ft. from 5 Chapotal has been made. Most of the acreage is controlled by the company and an orderly development program is anticipated.

Production Test Near at Fitzsimmons Outpost

Humble 2-E J. F. Welder, a wildcat located about 4 miles northwest of the Fitzsimmons field, Duval County, was being prepared for a production test after a drill-stem test recovered pipe-line oil. Oil sand was cored at 2,461-67 ft., and a 9-minute drill-stem test recovered 130 ft. of oil and 230 ft. of drilling mud. Casing is being cemented on bottom. The well is located in the E. N. Gray Survey 224, about 1,630 ft. southeast of the company's 1-E Welder, a dry hole which was abandoned the previous week at 4,513 ft. This is a highly regarded prospect in which Atlantic Refining Co., Magnolia Petroleum Co., Stanolind Oil & Gas Co., Mills Bennett Production Co., and Quintana Petroleum Co. hold considerable protection.

Extension to Sweden Field Is Completed

Additional development is expected to be started in the Sweden field, Duval County, with the completion of Hiawatha Oil & Gas Co. 6 Herberger, southwest of production which is flowing at the rate of 10 bbl. of pipe-line oil per hour while testing through perforated casing at 4,932-37 ft. This is one of the best producers completed in the field, and apparently opens production from a new sand lens in the Jackson. Previous development has resulted in largely gas-distillate production.

Corpus Christi Area Operations Include Agua Dulce Test

In the Corpus Christi area, and located in the Banquette area, 1⅛ miles northeast of the Agua Dulce field, Nueces County, W. B. Osborn and Mid-Continent Petroleum Co. were preparing to test 1 E. Grove. Total depth of the hole is 7,538 ft., and 5½-in. casing was cemented at 7,078 ft., preparatory to testing sand at approximately 6,900 ft. from which the well attempted to blow out. The well is about ⅝ mile south of the same operator's 1 Burow, completed during the early part of the year as a gas-distillate producer. Only a limited amount of drilling has been done in the area, and promise of opening crude production from down dip sands is encouraging.

The new producing area recently opened on the north side of the Agua Dulce field, Nueces County, was defined with the abandonment of S. E. W. Oil Co. 9 First Trust Joint Stock Land Bank at a total depth of 5,810 ft. The well is located in the Briggs & Kuykendall subdivision about 1,300 ft. northeast of production.

In the Mathis area, San Patricio County, Argo Oil Corp. is moving in material for a 4,900-ft. test located on the M. V. Wright estate, about 2 miles northwest of the town of Mathis in the M.P.&J.N. Delgado Survey. The location is about ½ mile southwest of Fred W. Shield 1 J. N. Clemons, recently abandoned at 4,878 ft. This well logged gas-distillate sands in the Vicksburg, but the sand was found too tight for commercial production.

LOWER GULF COAST DISTRICT

Fields

Agua Dulce, Nueces County: H. H. Howell 8 Schulze, 176 bbl., ¼-in. choke, perf. casing 6,512-26 ft., T.D. 6,980 ft.
S. E. W. Oil Corp. 7 First Trust Joint Stock Land Bank of Chicago, 72 bbl., ⅛-in choke, perf. casing 5,516-39 ft., T.D. 5,637 ft.
Texon Royalty Co. 4 Horner, 215 bbl., ½-in. choke, perf. casing 7,005-35 ft., T.D. 7,040 ft.
Clara Driscoll, Nueces County: Texas Conservative 1 Taylor, 135 bbl., ⅛-in. choke, perf. casing 5,254-60 ft., T.D. 5,457 ft.
East Flour Bluff, Nueces County: Humble 1-D Ritter, dry, T.D. 6,810 ft.
Humble 1-L State, 201 bbl., ⅛-in. choke, sand 6,774-91 ft.
Fagan, Refugio County: Seatex 1 B. J. Fox, 76 bbl., 5/32-in. choke, perf casing 5,548-53 ft., T.D. 5,938 ft.
Minnie Bock, Nueces County: Graham 2 Connelly, dry, T.D. 3,843 ft.
Richard King, Nueces County: Southern Minerals 20 King, 84 bbl., ⅛-in. choke, perf. casing 5,598-5,603 ft., T.D. 5,610 ft.
Southern Minerals 15 Walker, 20 bbl., ⅛-in. choke, perf. casing 6,129-22 ft., T.D. 6,104 ft.
Seeligson, Jim Wells County: Magnolia 22 Seeligson, 144 bbl., 7/64-in. choke, perf. casing 5,909-13 ft., T.D. 5,920 ft.
Victoria, Victoria County: S. Stewart Boyle 3 Fox, 87 bbl., pumping, perf. casing 3,018-20 ft., T.D. 3,049 ft.
Wade City, Jim Wells County: W. R. Quinn, dry, T.D. 4,932 ft.
West Tuleta, Bee County: Salt Dome Oil Corp. 3-A Mercantile Co., dry, T.D. 3,086 ft.
Woodsboro, Refugio County: Sinclair Prairie 2 Boenig, dry, T.D. 6,820 ft.

LAREDO DISTRICT

Wildcats

Duval County: H. H. Howell 1 Escabor, dry, T.D. 6,060 ft.
Humble 1-E Welder, dry, T.D. 4,513 ft.
Luling 1 F. Salinas, dry, T.D. 5,512 ft.
McMullen County: Glenda Oil Co. 1 Reed, dry, T.D. 1,588 ft.
Webb County: W. R. McBride 1 Garza, dry, T.D. 2,409 ft.
Transwestern 1 Puig, dry, T.D. 2,134 ft.

Fields

Alta Mesa, Brooks County: Standard Oil Co. of Texas 18 Mestena, 105 bbl., pumping, sand 3,011-27 ft.
Colorado, Jim Hogg County: Humble 40-B Puig, 175 bbl., 4/64-in. choke, T.D. 2,857 ft.
Humble 39-B King, 203 bbl., 4/64-in. choke, T.D. 2,862 ft.
C. Andrade 3-H Trevino, 156 bbl., 4/64-in. choke, sand 2,884-92 ft.
Glen, Webb County: Holland et al 1-B Bruni, 26 bbl., pumping, T.D. 2,195 ft.
Kelsey, Brooks County: Humble 83 McGill, 143 bbl., 9/64-in. choke, T.D. 4,969 ft.
Killam, Webb County: O. W. Killam 19 Garcia, 66 bbl., pumping, perf. casing 2,017-24 ft., T.D. 2,076 ft.
Lundell, Duval County: Humble 16-B Paul E. White, dry, T.D. 1,547 ft.
Nichols, Hidalgo County: Phillips 4 Town, dry, T.D. 4,350 ft.
Rincon, Starr County: Continental 108-A Slick, 10 bbl. 12 hr., 4/64-in. choke, perf. casing 3,832-50 ft., T.D. 4,165 ft.
Navarro 2 Trevino, 119 bbl., ⅛-in. choke, T.D. 4,804 ft.
Sun, Starr County: Sun 2 Perez, 114 bbl., pumping 4,670-75 ft.
Tarancahuas, Duval County: Plymonth 3-C Hoffman, dry, T.D. 3,461 ft.

SOUTH CENTRAL TEXAS DISTRICT

Wildcats

Atascosa County: C. G. Newton 1 Haverlah, dry, T.D. 650 ft.
Bexar County: G. C. Summer 1 Peterson, dry, T.D. 1,287 ft.
Milam County: W. S. Shadrach 2 Donaldson, dry 50 ft.

Fields

Bee Creek, Caldwell County: Ralph Ogden 2-E Miears, 150 bbl., 12 hr. open tubing, T.D. 2,342 ft.
Elgin, Bastrop County: Marts & Beaven 1 S. A. Cartwright, top Edwards lime 3,365 ft., dry, T.D. 3,610 ft.
Gas Ridge, Bexar County: Southwest Drilling 34 Covell, 3 bbl., pumping, top pay 431 ft., T.D. 469 ft.

SOUTHWEST TEXAS DRILLING REPORT

Dimmit County: Wellington 1-B Sullivan, E. H. Carll Sur. 602, drilling shale 1,391 ft.
Gonzales County: Randon Oil Co. 1 Dunning, T.D. 5,809 ft., reaming.
Hidalgo County: W. R. Davis 1 Jackson, drilling shale 2,700 ft.
Jim Hogg County: Lon H. Cron 1 Hellen, Ygnacio Mora Sur. 24, dry, T.D. 3,620 ft.
Starr County: Magnolia 1 Hinojosa, drilling shale 4,095 ft.
Sun 1 Jones, Agua Neuva de Abajo grant, coring salt water sand 3,327 ft.
Sun 1-C Montalvo, Los Tetaches grant, drilling shale 50 ft.
Webb County: Magnolia 2 Santos Tomas, Santo grant, drilling shale 772 ft.
Willacy County: Clark & Cowden 2 Yturria, La Sal Vieja area, drilling shale 5,400 ft.
Willacy County: Pan American 1-C Hodge, San Juan de Carricitos grant, Willamar field, T.D. 7,861 ft. 7-in. casing 7,846 ft., testing.
Zapata County: Ralph E. Fair 1 Flores, Porcion 36, Block 42, drilling shale 60 ft.

Oil Strikes Showing in Clay And Montague Counties

By D. H. STORMONT

WICHITA FALLS, Tex., Nov. 3.—Another Caddo lime oil pool for this district is in prospect in Throckmorton County. During the week, Nash & Windfohr 1 Parrott, Block 957, T.E.&L. Survey, 5 miles northwest of the town of Woodson, flowed 72 bbl. of oil and 5 bbl. of water in 24 hours from the Caddo lime section. The lime was topped at 4,003 ft. and the saturated section drilled from 4,003-24 ft., total depth. The test started flowing after 7-in. casing was cemented on top of the lime and the section treated with 3,000 gal. of acid. Operators will continue to test before attempting completion.

In Montague County, Continental Oil Co.'s wildcat in Block 4, Limestone C.S.L. Survey, found production in the Nocona lime. On a 20-minute drill-stem test of the lime at 6,235-58 ft., the wildcat, Continental 1 Winder, showed gas in 3 minutes and at the end of the test had recovered 1,810 ft. of oil and 340 ft. of salt water. Flowing pressure was 800 lb. and bottom-hole pressure was 3,000 lb.

The Nocona lime is in the Bend series of the Pennsylvanian. No. 1 Winder will be drilled deeper to test the Mississippi before any completion attempts are made.

SUMMARY OF COMPLETIONS

North Texas

	No.	Bbl.	Footage
Oil wells: Antelope	2	723	6,437
K.M.A.	6	377	25,069
Other fields	2	13	5,661
Miscellaneous pools	18	1,034	48,399
Wildcats	3	194	10,316
Dry holes: Fields	2	.....	4,432
Miscellaneous pools	9	.....	11,054
Wildcats	3	.....	8,058
Total	45	.....	119,426

West Central Texas

	No.	Bbl.	Footage
Oil wells: Fields	6	859	11,617
Gas wells: Pottsville	2	*14.4	5,534
Wildcats	1	.35	3,566
Dry holes: Fields	2	.....	7,035
Wildcats	7	.....	9,556
Total	18	.....	37,308

*Million cu. ft.

Developmental Programs Scheduled For Clay and Jack Counties

As a result of recent discoveries, three areas in Clay County and one in Jack County are preparing to undergo drilling campaigns. Two of the tests in Clay County will go to 6,000 ft. and one to 5,500 ft.

Moving ¾ mile northwest of its 5 Worsham, which is testing at 5,868 ft., Gulf has staked 6 Worsham in the NE cor. SE Section 34, Block 4, H.&T.C. Survey. No. 5 Worsham, J. W. Swisher Survey, was completed several years ago at 3,500 ft. but has since been deepened. Last September, the test swabbed 57 bbl. of oil and no water in 4½ hours from the conglomerate at 5,641 ft.

The second scheduled 6,000-ft. test was staked by L. T. Burns at 4 Wynn, Block 34, H. Williams Survey. No. 4 Wynn is a 1,320-ft. north offset to 1 Wynn, which flowed an estimated 275 bbl. of oil daily from 5,905-67 ft., after being deepened from 5,206 ft.

An outpost location to the Ross pool has been staked by Continental, Superior and Dillard on the 160-acre Dillard tract. The new test is in the southwest corner of Block 32, J. Massie Survey, and is contracted to 5,500 ft., the horizon from which production is derived in the Ross pool.

In Jack County, Hanlon-Buchanan, Inc., has staked five locations in the vicinity of Taubert & McKee 1 Hoefle, A. James Survey, in the northwestern part of the county. Two direct offsets were staked to the discovery well, 1-B Hoefle, south offset, and 1-C Hoefle, west offset.

Meanwhile, 1 Hoefle on last gage reported flowed 205 bbl. of oil in 5 hours through ¼-in. choke. Casing pressure gaged 700 lb. at the beginning of the test and 450 lb. at the end. Tubing pressure was 500 lb. at the beginning and 215 lb. at the end. At the end of the week the test was shut in for official gage.

Two Wildcats Staked in Wise County

Two deep wildcats, the first Wise County has enjoyed in more than a year, were staked by H. L. Hunt. Both locations were made on farmout acreage from the Pure Oil Co. In the extreme northwest corner of the county, near Park Springs, Hunt has made location for 1 W. H. Halman, in the south 80 acres of the George W. Cash Survey, Abstract 166, 4 miles north of Chico. The wildcat, which will be drilled in the immediate future, is contracted to 6,000 ft., or to the Bend conglomerate.

The second wildcat is 1 L. Briley, located in the center of the south 20 acres of the Adam Johnson Survey, Abstract 1330, ½ mile northwest of Chico. The test is contracted to 7,000 ft., but whether or not it will be drilled depends on the outcome of 1 Halman.

Wimberly Play Results in South Extension; Field Rules Issued

FORT WORTH, Tex., Nov. 3.—The increased activity in and around the Wimberly area in southern Jones County noted during the last few weeks appears to have assured a ½-mile south extension to the pool. Clark & Cowden found pay at North Wimberly, SE Section 105, De Witt C.S.L. Survey. The producing sand was topped at 2,214 ft. and at the present time the test is bottomed at 2,219 ft. Production in the Wimberly area is derived from three separate pay levels.

Coleman and Stephens Counties Get Wildcats

Six miles south of Santa Anna in Coleman County, R. M. Coleman has staked location for 1 C. S. Kingsberry. The wildcat will be drilled to 2,300 ft. Location is on a 155-acre tract in the Wharton C.S.L. Survey. With drilling operations scheduled to start immediately, Benton & Roach have announced the location of a 2,000-ft. wildcat, 6 miles south of Caddo in Stephens County. The test will be drilled as 1 Nellie Caraway, located on a 220-acre lease in Section 79, Block 4, T.&P. Survey.

Field Rules Issued for Three Pools In Jones and Coleman Counties

The Railroad Commission last week issued orders setting well spacing, method of allocation and development rules for the Wimberly pool in Jones County and for the Jim Ned and Silver Valley pools in Coleman County. In the Silver Valley pool well spacing was set at 933 ft. between wells and 467 ft. from lease lines, while in Jim Ned and Wimberly well spacing was set at 660 ft. and 330 ft.

Proration units were established at 40 acres with a tolerance of 20 acres in the Silver Valley pool, and at 20 acres in the other two pools. A 19-acre tolerance for the last well on the lease was set for Jim Ned while a 10-acre tolerance was set in the Wimberly pool. The daily allowable in the Wimberly and Silver Valley pools is to be distributed on a 50 per cent well and 50 per cent acreage basis; in Jim Ned, on a 75 per cent acreage and 25 per cent per-well basis. Maximum gas-oil ratio was set at 2,000 cu. ft. per barrel in Silver Valley and Wimberly and at 3,500 cu. ft. in Jim Ned, with rules in all three fields including volumetric withdrawal provisions for penalizing high gas-oil ratio wells.

WEST CENTRAL TEXAS COMPLETIONS

Wildcats

Brown County: R. D. Herring 1 A. A. Martin, Sec. 44, H.&T.C. Sur., dry at 1,303 ft.

Callahan County: Cordova-Union Oil Corp. 1 John Windon, Lot 21, Victoria C.S.L. Sur., dry at 1,508 ft.

C. D. Roberts 26 W. Grandy, NE NW Sec. 2977, T.E.&L. Sur., dry at 580 ft.

Coleman County: States Oil Corp. 1 Jessie Hughes, Sec. 34, G.H.&H. Sur., Blk. 2, 353,000 cu. ft. gas in 24 hr., 40-qt. shot 3,310-35 ft., T.D. 3,566 ft.

Comanche County: O. L. Stutenroth 2 Pearl Kirk, John Talbot Sur., Abst. 941, dry at 2,800 ft., 1,000 gal. acid.

Eastland County: E. M. Thomason 1 J. L. Busbee, Sec. 7, E.T. Sur., Blk. 2, dry at 600 ft.

McCulloch County: D. H. Brock 1 S. E. Fox, Ludwig Javer Sur., A-944, dry at 1,184 ft., top Ellenburger 1,128 ft.

Shackelford County: C. J. Kleiner 1 Dawson & Conway, Luke Bryan Sur. 24, dry at 1,581 ft.

Fields

Albany, Shackelford County: Mrs. Mammie J. Cross 17 A. S. Spears, Sec. 1, B.A.L. Sur., 6 bbl. in 24 hr., pay 725-33 ft.

Akard, Jones County: Petroleum Producers Co. 5 Dorothy Akard, Guadalupe Martinez Sur. 137, 210 bbl. in 24 hr., pay 2,139-44 ft.

Bluff Creek, Shackelford County: Fain-McGaha Oil Corp. 7 J. P. Morris, Sec. 197, E.T. Sur., 48 bbl. in 24 hr., pumping, 15-qt. shot 1,508-12 ft., T.D. 1,552 ft.

C. W. Hoffman 39 J. P. Morris, Sec. 200, E.T. Sur., dry at 1,652 ft.

Nail, Shackelford County: Hickok & Reynolds 15-A J. H. Nail, Sec. 133, E.T. Sur., 149 bbl. in 8 hr., est. 300 bbl., pay 1,600-07 ft.

Novice, Coleman County: States Oil Corp. 1 C. F. Sprinkler, Sec. 46, C.H.&H. Sur., Blk. 2, 287 bbl. in 13 hr., ¾-in. choke, est. 500 bbl., pay 3,593-3,624 ft., T.D. 3,629 ft.

Pottsville, Hamilton County: Lone Star Gas Co. 1 John W. Harris, G.H.&H. Sur., 686,000 cu. ft. gas in 24 hr., top Marble Falls 2,648 ft., pay 2,668-2,744 ft., 5,000 gal. acid, T.D. 2,822 ft.

Lone Star Gas Co. 1 T. J. Burks, James Hays Sur. 16, Pat. D-705, 750,000 cu. ft. gas in 24 hr., pay 2,585-2,674 ft., 8,000 gal. acid, top Marble Falls 2,565 ft., T.D. 2,712 ft.

Sayles, Jones County: Condor Petroleum Co. 34 Henry Sayles, Sec. 5, T.&P. Sur., Blk. 20, 159 bbl. in 24 hr., pumping, pay 1,928-51 ft., T.D. 1,952 ft.

Triplett, Jones County: Ungren & Frazier 1 W. H. Hollis, Sec. 21, Blk. 15, T.&P. Sur., dry at 2,940 ft.

View, Taylor County: Tal-Vez Oil Co. 2 J. J. Smith, Henry S. Day Sur., dry at 2,443 ft.

WEST CENTRAL TEXAS ACTIVE WILDCATS

Callahan County: Rhodes Drilling Co. 1 R. H. Seale, 2,310 ft. from S and W lines, Lewis Johnson Sur. 252, 1,250-ft. cable tool test, S.D. 160 ft., repairs.

W. B. Schooler 1 Betcher, 330 ft. from N and W lines, Sec. 7, Blk. 6, S.P. Sur., 2,500-ft. cable-tool test, drilling 1,495 ft.

Ungren & Frazier 2 Ethel Burks, 600 ft. from S and W lines, Sec. 116, B.B.B.&C. Sur. ,1,300-ft. cable-tool test, drilling 783 ft.

Coleman County: A. P. Hienze 1 Wittington, NW SE Sec. 4, Blk. 2, T.&N.O. Sur., 3,800-ft. test, S.D. 1,005 ft., for casing.

Merry Bros. & Perini 1 Greer, 1,283 ft. from S and 467 ft. from W lines, Lot 2, H. Kegans Sur. 520, 4,000-ft. rotary test, flowing 160 bbl. in 11 hr., working on casing.

States Oil Corp. 1 T. J. Hudson, 467 ft. from S and W lines, Sec. 74, H.H.&H. Sur., Blk. 2, 3,600-ft. test, drilling 2,940 ft.

West Coast Prod. Corp. 1 Norris, SW cor. of NE 160 ac., J. Greenwood Sur. 304, S.D. 3,263 ft., orders.

Comanche County: C. D. Lane 1 W. T. Hazzard, 3,889 ft. from NW and 1,806 ft. from NE lines of Marmaduke Hatton Sur., Abst. 424, 2,900-ft. cable-tool test, first report.

Concho County: C. M. Joiner Leasing Corp. 1 G. R. Armor, 1,315 ft. from S and 330 ft. from W lines, Sec. 105, Blk. 72, T.&N.O. Sur., old well drilling deeper, old T.D. 1,565 ft., drilling 3,350 ft.

Eastland County: Stewart Oil 1 Shaeffer, 660 ft. from E and 1,980 ft. from S lines, 394-ac. farm in Moses Allen Sur. 26, 3,500-ft. test, drilling 1,900 ft.

Fisher County: P. R. Long 1 Maberry, SE cor. A. A Soring Sur., 2 mi. SW of McCaully, pumping 10 bbl. oil and 90 bbl. water at 3,289 ft.

Shell 1 Vaughn, 467 ft. from N and 1,787 ft. from W lines, Sec. 205, Blk. 21-V, H.&T.C. Sur., 7,200-ft. test, S.D. 6,821 ft., orders.

Haskell County: J. A. Worsham 1 McLennan, 440 ft. from S and W lines, 370-ac. farm in S. C. Robertson Sur. 4, Abst. 352, 3,500-ft. rotary test, drilling 1,320 ft.

Edward C. Lawson 1 C. C. Rose, 489 ft. from S and 440 ft. from E lines of 392-ac. tract, J. McCass Sur. 57, Abst. 95, drilling 1,792 ft.

Jones County: J. B. Cunningham 1 J. B. Freeman, 330 ft. from W and 2,000 ft. from S lines, Alex Glenn Sur., 2,800-ft. cable-tool test, drilling 150 ft.

Fain-McGaha 1 Hollis, 330 ft. from E and 1,300 ft. from N lines, NW Sec. 26, Blk. 15, T.&P. Sur., 2,500-ft. test, testing at 2,503 ft.

Roeser & Pendleton 1 Moore, 242 ft. from N and 330 ft. from E lines of 40-ac. farm in E part of Sec. 33, Blk. 15, T.&P. Sur., 2,300-ft. cable-tool test, drilling 2,169 ft.

W. L. Snoddy 1 Huddleston, 2,150 ft. from S and 467 ft. from W lines of farm in E part of Sec. 41, Blk. 18, T.&P. Sur., 3,000-ft. test, drilling 2,080 ft.

Ungren & Frazier 1 S. J. Peyton, 330 ft. from S and 1,070 ft. from E lines of 100-ac. tract, Stephen M. Hale Sur. 251, drilling 1,364 ft.

Merry Bros. & Perini 1 A. H. Lundgren, 480 ft. from N and 467 ft. from E lines of W½ of N¼ Sec. 20, Blk. 3, H.&T.C. Sur., 3,500-ft. rotary test, first report.

Palo Pinto County: Hickok & Reynolds 3 Gauldin. 467 ft. from S and E lines, Sec. 1756, T.E.&L. Sur., drilling 4,730 ft.

E. Lloyd 1 C. A. Dalton, 560 ft. from S and 1,165 ft. from E lines of W. Lewis Sur. 83, Abst. 299, 1,500-ft. test, drilling 410 ft.

Shackelford County: L. L. Rector 1 Grimes, 150 ft.

from S and W lines, NW Sec. 75, Blk. 12, T.&P. Sur., S.D. 1,304 ft., orders.

Stonewall County: Forest Dev. Oil Corp. 2 C. E. Boyd, 990 ft. from N and 1,700 ft. from W lines, Sec. 45, Blk. D, H.&T.C. Sur., 5,100-ft. rotary test, first report.

Stephens County: Daniel & Pardue 1 W. A. Corbett, 440 ft. from S and 940 ft. from W lines, 240-ac. lease, Sec. 11, S.P. Sur., 3,350-ft. rotary test, running 7-in. casing 3,003 ft.

T. S. Schroeder 1 Corbett, 2,200 ft. from E and 444 ft. from N, Sec. 12, Blk. 3, S.P. Sur., P.B. to 3,955 ft., treated with 5,000 gal. acid, 3,000,000 cu. ft. gas, spraying oil.

T. G. Shaw, trustee, 1 E. Whalen, 467 ft. from N and W lines of Sec. 1089, T.E.&L. Sur., Abst. 370 4,200-ft. rotary test, drilling 2,885 ft.

Taylor County: Butler & Horne Drilling Co. 1 Merchant, 330 ft. from N and 2,687 ft. from W lines, S½ Sec. 30, Blk. 16, T.&P. Sur., 2,800-ft. cable-tool test, drilling 910 ft.

Deep Oil Dev. Co, 1-A J. E. Higgins, 330 ft. from N and 360 ft. from E lines, Lot 8, C. B. Corley Sur., 2,850-ft. cable-tool test, drilling 2,800 ft.

Ungren & Frazier 1 Trinity University, 330 ft. from S and W lines, E 32.7-ac. tract, Lot 2, Grimes C.S.L. Sur. 148, 2,900-ft. cable-tool test drilling 2,918 ft.

Tom B. Medders 1 J. W. Moore, 990 ft. from W and 330 ft. from S lines of SE Sec. 74, Blk. 19, T.&P. Sur., 3,150-ft. cable-tool test, first report.

NORTH TEXAS COMPLETIONS

Wildcats

Clay County: N. H. Martin & Son 1 C. H. McClellan. Sec. 22, Knott subd., dry at 1,410 ft.

Cooke County: James L. Anderson 1 A. L. Orsborn. B. Sullivan Sur., Abst. 581, 10 bbl. in 24 hr., pumping, pay 2,309-20 ft.

Kimber & Bohner 1 Phillips & Herman, J. Collinsworth Sur., Abst. 211, dry at 2,525 ft.

Grayson County: Brown & Laves 1 N. L. Stephenson Charles Quillen Sur., Abst. 989, dry at 4,123 ft.

Wichita County: Kemrow Production Co. 57 S. B. Burnett, Sec. 6, H.&T.C. Sur., Abst. 428, 9½ bbl. in 24 hr., and 9 bbl. water, pumping, top Ellenburger 3,648 ft., acidized with 1,000 gal. at 1,898-1,908 ft., T.D. 3,731 ft.

Young County: Kerlyn Oil Co. 1 E. Taylor, Sec. 2, B.S.&F. Sur., Abst. 2265, 174 bbl. in 24 hr., est. 600 bbl., pay 4,255-65 ft.

Fields

Antelope, Clay County: Shell 4 Henderson, Sec. 2616, T.E.&L. Sur., 98 bbl. in 8 hr., est. 225 bbl., pay 3,215-51 ft.

Shell 15 H. Henderson, Sec. 2605, T.E.&L. Sur., 248 bbl. in 8 hr., est. 625 bbl., pay 3,151-86 ft.

Briar Creek, Young County: Panhandle Ref. Co. 3 C. W. Guinn, F. Jaime Sur., dry at 2,854 ft.

Bryson, Jack County: Nelson Oil Synd., Inc., 3 O. D. Birdwell, T. B. Riddle Sur., 5 bbl. oil and 5 bbl. water in 24 hr., pumping, 7,000 gal. acid, pay 4,025-44 ft., T.D. 4,507 ft.

K.M.A., Archer County: Deep Oil Dev. Co. 3-A E. P Griffin, Sec. 13, Palo Pinto C.S.L. Sur., Abst. 339, 78 bbl. in 3 hr., ¾-in. choke, est. 190 bbl., pay 4,371-73 ft., T.D. 4,393 ft.

K.M.A., Wichita County: Hanlon-Buchanan 27 Fassett & Tuttle C, Sec. 24, S.A.&M.G. Sur., Abst. 766, 50 bbl. in 3 hr., ¼-in. choke, est. 250 bbl., 190-qt. shot 4,038-78 ft., T.D. 4,080 ft.

Hanlon-Buchanan 39 Fassett & Tuttle, C.T. Sur., Abst. 769, 66 bbl. in 3 hr., ¾-in. choke, est. 325 bbl., top K.M.A. 3,794 ft., 120-qt. shot 3,935-66 ft., T.D. 3,970 ft.

Bishop Oil Co. 2-E J. and J. Waggoner, Sec. 1, G.C. Sur., Abst. 782, 60 bbl. in 3 hr., ½-in. choke, est. 190 bbl., 4,000 gal. acid, 25-qt. shot 3,889-97 ft.

Shell and Phillips 6-B D. R. Preston, Sec. 27, Blk. 7, H.&T.C. Sur., 73 bbl. in 24 hr., 103 bbl. of water in 24 hr., pumping, top K.M.A. 3,818 ft., Ellenburger 4,458 ft., 3,000 gal. acid 4,466-89 ft.

Tide Water and Perkins-Cullum 13 Charles Pettit, Sec. 28, Blk. 7, H.&T.C. Sur., 50 bbl. in 3 hr., ¼ in. choke, est. 325 bbl., top Caddo 3,829 ft., Ellenburger 4,144 ft., T.D. 4,239 ft.

Nocona, Montague County: Birdwell Oil Co. 4-D T. and H. Begley, William Donoho Sur., Abst. 178, dry at 1,578 ft.

T.C.U., Cooke County: Frank & Fred Jones Drilling Co. 1 C. J. Fette, J. L. Townsley Sur., Abst. 1551 8 bbl. oil and 10 bbl. water in 24 hr., pumping, pay 1,150-54 ft.

Miscellaneous Fields

Archer County: M. M. Bradley 2 Lena Maxwell, Sec. 1, B.B.B.&C. Sur., Abst. 37, dry at 1,257 ft.

Petroleum Producers Co. 8-B J. T. Richardson, E.L. Sur., Abst. 687, 9 bbl. in 24 hr., pumping, pay 1,291-1,306 ft.

Petroleum Producers Co. 4 G. A. Lauster, Sec. 2, S.P. Sur., Abst. 1237, dry at 1,339 ft.

Guy J. Brown 4-E J. J. Perkins, League 3, Blk. 27, Denton C.S.L. Sur., 10 bbl. in 24 hr., pumping, pay 1,794-1,804 ft.

Gulf 26 P. Seigel, Sec. 22, Lot 3, A.T.N.C.L. Sur., 72 bbl. 3 hr., 250,000 cu. ft. gas per day, est. 190 bbl., 4,000 gal. acid, 100-qt. shot 3,965-4,406 ft.

W. B. Hamilton 8-B C. E. Graham, J. Levins Sur., Abst. 259, 65 bbl. in 24 hr., pumping, 1,000 gal. acid 1,136-47 ft.

R. H. Hawn 1 A. B. Edwards, Sec. 33, Lula P. Hunt subd., 114 bbl. in 2 hr., ¾-in. choke, est. 500 bbl., top Caddo 5,224 ft., 1,000 gal. acid 5,224-50 ft., P.B. from 5,630 ft., T.D.

Shell 4 W. M. Coleman B, Sec. 74, Lot 1, A.T.N. C.L. Sur., 333 bbl. in 6 hr., est. 950 bbl., top Caddo

(Continued on Page 223)

It's a Fact — Johnston

DO YOU KNOW THAT YOU CAN WALK AWAY FROM SOME POOLS OF CRUDE OIL AND LEAVE YOUR SHADOW BEHIND—IN THE POOL? IT'S A FACT! WHEN EXPOSED TO BRIGHT SUNLIGHT, CERTAIN CRUDES WILL RETAIN A SHADOW AFTER THE OBJECT CASTING IT HAS BEEN REMOVED. UNEQUAL EVAPORATION AND DIFFERENCE IN BLEACHING DUE TO "BLOTTING OUT THE SUN" IS THE EXPLANATION.

BUT YOU CAN REMOVE ALL SHADOW OF DOUBT ABOUT THE PERFORMANCE OF YOUR WELLS IF YOU DEVELOP EVERY ONE LOGICALLY AND EFFICIENTLY WITH THE JOHNSTON FORMATION TESTER. IT TELLS THE EXACT PRODUCTION POSSIBILITIES OF EVERY SAND YOU DRILL BEFORE CASING IS SET—WHICH ARE WET, WHICH ARE DRY, WHICH WILL PRODUCE OIL OR GAS. THE JOHNSTON TESTER OPENS THE TEST ZONE TO UNOBSTRUCTED FLUID FLOW AND ALLOWS IT TO TELL ITS OWN STORY OF PRODUCTION CAPABILITIES. WITH THE PRESSURE RECORDS THE TESTER PROVIDES AT THE TIME THE TEST IS RUN, YOU HAVE THE COMPLETE STORY OF YOUR WELL. YOU SAVE TIME AND MONEY, ELIMINATE GUESSWORK, AND DEVELOP EVERY WELL MORE EFFICIENTLY AND PROFITABLY.

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"WHY SET CASING BEFORE YOU KNOW!"

CANADIAN FIELDS

Shallow Pools in Eastern Alberta Yield Fuel Base

By VICTOR LAURISTON

CHATHAM, Ont., Nov. 1—Crude and natural gasoline production from all Alberta fields for the week ending October 20 averaged 27,490 bbl. daily compared with 27,199 bbl. daily for the preceding week and 25,359 bbl. daily for the corresponding week last year. The daily average included 26,631 bbl. of crude and 668 bbl. of natural gasoline from Turner Valley and 191 bbl. from outside fields. There were 189 producing wells with 27 drilling, 2 finished drilling, 1 on production, 8 testing, 2 resuming, 6 drilling licenses issued and 1 new well spudded.

Turner Valley Allowables

A revised schedule of authorized production for Turner Valley crude wells for October, issued by the Alberta Conservation Board, shows aggregate legal allowables of 464,795 bbl. and total authorized production of 806,000 bbl., or 26,000 bbl. daily. Miracle Royalties 1 is the largest producer with 24,304 bbl. for the month: other large wells being Ace Aoyalties 1, with 24,273 bbl.; Major Oils 2m with 24,211 bbl.; Home Oil 7 with 21,076 bbl.; Home Oil 2 with 20,573 bbl. and Northwest-Hudson's Bay 6, with 20,119 bbl. All except the last named well are in North Turner Valley.

TURNER VALLEY LIME TESTS

North Turner Valley: Major Oils 3, LSD 1, 8-21-3w5, T.D. 8,120 ft., Madison at 7,655 ft., 65 bbl. hourly before acidizing, or 1,560 bbl. daily, 550 bbl. in 4 hours after acidizing. It looks like one of the largest producers in the field, and extends the proven area a half mile to the north. It is acidizing and testing for official allowable.

Act Royalties 1, LSD 5, 4-21-3w5, T.D. 8,834 ft., Madison at 8,335 ft., allowable set at 783 bbl. daily, the largest in the field.

Home Oil 9, LSD 9, 15-20-3w5, T.D. 8,478 ft., Madison at 7,974 ft., acidizing and testing.

West-Central Section: Okalta Oil 11, LSD 10, 24-19-3w5, T.D. 8,220 ft., Madison at 7,752 ft., acidizing and testing.

Drillers & Producers 1, LSD 13, 7-19-2w5, below 7,861 ft., Madison at 7,599 ft.

Alberta Pacific Royalties 1, LSD 14, 6-19-2w5, T.D. 8,334 ft., Madison at 7,872 ft., testing for quota after acidizing.

New Tests at Brooks

A new Alberta plains area is to be tested one mile south of Brooks, where Northwest Co., subsidiary of Imperial Oil has made location in LSD 16, 20-18-14w4. Cellar is being dug and test will spud within a few weeks. Location is on a structure geologized recently by a Northwest Co. seismograph party, and is about 25 miles southwest of the Steveville-Princess field. Some small gas wells in the vicinity of Brooks supply the town, but this is the first deep test undertaken for oil.

OUTSIDE DRILLING

Grease Creek: Grease Creek-Northwest 2, LSD 7, 13-29-7w5, below 800 ft.

Clearwater: Ram River Oils 2, 1-37-11w4, below 3,100 ft. after getting gas and Oil shows between 3,020 and 3,080 ft.

Livingstone Range: Royal Sun Petroleum 2, LSD 2, 17-13-3w5, rigging.

Keho Lake: Keho Dome Oils 1, LSD 3, 18-11-22w4, below 2,220 ft., drilling and cementing against caving after a second oil show and numerous gas pockets.

Lethbridge: Lethbridge Petroleum 1, LSD 12, 11-8-22w4, below 4,330 ft., Madison at 4,145 ft.

Steveville: Standard-McDougall Segur 1, LSD 3, 11-20-12w4, T.D. 4,034 ft., abandoned.

Standard of British Columbia 6 Princess, LSD 5, 27-20-12w4, location, a half mile north of Standard I Princess gasser.

Sarcee Development

Arrangements have been made between Highwood-Sarcee Oil Co. and Petroleum Corp. of Canada, headed by F. P. Byrne, for a test well on the Sarcee Indian Reserve in NW¼ 9-23-4w5, to spud about

(Continued on Page 228)

Designed For The Oil Industry

JUSTRITE "TWIN-BULB" APPROVED SAFETY LANTERN

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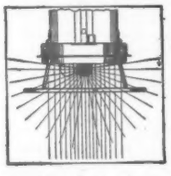

Either bulb gives light to sides plus powerful beam at same time. Extra bulb replaces other bulb at touch of the switch — no need to change position of lantern. Extra bulb can be equipped to give wide, diffused light or a colored beam, if desired.

Positive "Trouble-Free" Switch is entirely new in design. Controls both bulbs.

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Lantern uses two bulbs (Mazda 502 or 27) and standard lantern battery.

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MICHIGAN OPERATIONS

Roscommon County Lease Gets Third Big Producer

By OTTO C. PRESSPRICH

SAGINAW, Mich., Nov. 3.—Roscommon County got its third big oil well last week on a 40-acre lease for which the State of Michigan received $30,100 last summer. Ten other wells are drilling or planned in the field.

The new well, Mogul Oil Co. 1 State in Section 34, Roscommon Township, an offset to the Hilliard discovery of a few months ago, was rated at 2,400 bbl. a day. A 7-hour open-flow test averaged a little over 100 bbl. an hour. It was completed in the Traverse at 3,435 ft. J. V. Wicklund of Detroit heads the Mogul company.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells:			
Arenac County	1	20	4,692
Clare County	1	75	3,805
Genesee County	1	12	1,896
Lake County	1	1,600	3,711
Osceola County	4	15,600	14,384
Roscommon County	1	2,400	3,435
Van Buren County	1	10	1,304
Gas wells:			
Allegan County	1	*0.3	3,792
Isabella County	1	*0.5	1,285
Dry holes:			
Kent County	1	.....	2,093
Lake County	2	.....	6,724
Muskegon County	1	.....	2,327
Total	16	.....	49,488

*Million cu. ft.

Reed City Development Continues at High Peak

Meanwhile there is no letdown in Reed City development, featured last week by completion of Gulf Refining Co. 1 Bolger in Section 24 of Pinora Township, Lake County. After acidizing, the well produced 646 bbl. in 10 hours and promised more northwesterly operations in the expanding field. Approximately 70 wells now are producing in the current leading field in Michigan. Last week Ohio Oil Co. revealed plans for more extensive operations as the state Conservation Department approved permits for 14 more tests in eight sections of Lincoln Township, Osceola County

Four additional good producers were completed during the week, productivity ranging from the 7,775-bbl. a day rating for Ohio Oil Co. 3 Stedman in Section 30, to 600 bbl. from Don Rayburn B-1 Gabel in Section 31. Gulf B-1 Jewett in Section 31, after flowing 360 bbl. natural in 17 hours, was acid treated with the result that potential was boosted to 4,344 bbl. a day.

The completions report for the week listed 10 new oil wells, including Reed City's four, two small gas wells and four dry holes. Three locations were abandoned. One of the gas wells, Regal Dutch Petroleum Co. 2 Headley in Allegan County's Salem Township, rated at 304,000 cu. ft. a day, results from a deep test. The hole was drilled to 3,792 ft. for oil, then plugged back to 2,785 ft. for the gas. The other gasser, L. & S. Drilling Co. 1 Kobel, in Deerfield, Isabella County, is a discovery offset. It was rated at 497,000 cu. ft.

In another plug-back, Don Rayburn 1 Fox in Adams Township, Arenac County, was completed as a 20-bbl. oil producer at 4,310 ft. The hole had been drilled to 4,692 ft. Among the smaller completions was Hugh H. Heinig 1 Dodge, a Genesee County wildcat in Section 5, Forest Township. It was rated at 12 bbl. a day, with salt water, but may lead to additional development south from the Saginaw County, Birch Run Township tests which were of little importance a few years ago.

During the week the Conservation Department issued 22 drilling permits to bring the total for the year to 803. Fifteen were for Osceola County development, four for Allegan County, one each for Van Buren, Roscommon, and Lake counties.

MICHIGAN COMPLETIONS

Allegan County

Salem Township: Regal Dutch Petroleum Co. 2 Heasley, SE NW NE 21-4n-13w, 304,000 cu. ft. natural gas, T.D. 2,785 ft., P.B. from 3,792 ft.

Arenac County

Adams Township: Don Rayburn 1 Fox, NE NE SE 21-19n-3e, 20 bbl., acid, T.D. 4,310 ft., P.B. from 4,692 ft.

Clare County

Winterfield Township: Sun Oil Co. 2 Hamer, NE SE NW 29-20n-6w, 75 bbl. and salt water, acidized, T.D. 3,805 ft.

Genesee County

Forest Township: Hugh H. Heinig 1 Dodge, wildcat, SE SW SE 5-9n-8e, 12 bbl. and salt water, acidized, T.D. 1,896 ft.

Isabella County

Deerfield Township: L. & S. Drilling Co. 1 Kobel, NE NW NW 29-14n-5w, 497,000 cu. ft. gas, T.D. 1,285 ft.

Kent County

Cascade Township: Jetter & DeKrafft 1 Shilton, NW NW NW 13-6n-10w, wildcat, dry, T.D. 2,093 ft.

Lake County

Dover Township: Voorhees Drilling Co. 1 Kellogg, C NE NW 14-20n-11w, wildcat, dry, T.D. 3,851 ft.

Pinora Township: Gulf Refining Co. 1 Bolger, C S½ SE NE 24-18n-11w, 646 bbl. in 10 hr., acidized, T.D. 3,711 ft.

Sauble Township: William P. Shoemaker 1 Smith, SE NW SE 17-19n-14w, wildcat, dry, T.D. 2,873 ft.

Muskegon County

Ravenna Township: Robert L. Sanders 1 Shavalier, SE SE NW 28-9n-14w, SE SE NW 28-9n-14w, wildcat, dry, T.D. 2,327 ft.

Osceola County

Lincoln Township: Pure Oil Co. 3 Small, C N½ NW NE 29-18n-10w, 2,880 bbl., T.D. 3,562 ft.

Ohio Oil Co. 3 Stedman, C N½ NE NE Sec. 30, 7,775 bbl., T.D. 3,612 ft.

Don Rayburn B-1 Gabel, C N½ NW SW Sec. 31, 600 bbl., T.D. 3,636 ft.

Gulf Refining Co. 2 Truax, C N½ NE NE Sec. 19, location abandoned.

Gulf Refining Co. B-1 Jewett, C N½ SE SE Sec. 31, 4,344 bbl., acidized after flowing 360 bbl. natural first 17 hr., T.D. 3,574 ft.

Roscommon County

Roscommon Township: Mogul Oil Co. 1 State, C S½ NE SE 34-21n-3w, 2,400 bbl., T.D. 3,435 ft.

Van Buren County

Bloomingdale Township: C. J. Stevens, Tr., 1 Schindler, NE SE NE 10-1s-14w, 10 bbl. and water, acidized, T.D. 1,304 ft.

Jetter Drilling Co. 1 Baird, SE SE NW Sec. 14, location abandoned.

Globe Drilling Co. 1 Kahl, SW SE SE Sec. 14, location abandoned.

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Amt. in form of Glucosate	Amt. as dichromate	Application	Saving
	SODIUM BICHROMATE		
17 pounds	100 pounds	Calcium Brine	83 lbs.
17 pounds	200 pounds	Salt Brine	183 lbs.
34 pounds	500 pounds	Cooling Water	466 lbs.
	CHROMIC ACID		
3 pounds	66 pounds	Calcium Brine	63 lbs.
3 pounds	132 pounds	Salt Brine	129 lbs.
10 pounds	330 pounds	Cooling Water	320 lbs.

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Deep Exploration in Basin Halted by Louden Failure

By STAFF CORRESPONDENT

MATTOON, Ill., Nov. 3.—Hopes of a new producing horizon in the Louden field faded last week when the Carter 6 Jennie Bauer, SE SE 21-8n-3e, failed to find saturation in the St. Peter sand and was being plugged back to be completed in the Devonian, newest of the field's four producing horizons. No. 6 Jennie Bauer has been one of the most closely watched tests in the Illinois basin during the past few weeks because of the fact that the St. Peter has not been extensively explored in the basin and has not yet produced oil anywhere in the state. The St. Peter was topped at 4,458 ft. at 6 Bauer and the total depth of the test was 4,679 ft.

The recording of the dry hole in the St. Peter horizon on the Louden structure, coupled with the dry hole reported in that horizon by the Texas Co. several months ago in the Salem field, is expected to discourage any further immediate exploration to that horizon since these are two of the largest oil-producing structures in the state. This dry hole also partially confirms the belief of many Illinois oil men that the St. Peter will not produce commercially in the state.

Parkersburg Extended Southwest Into Edwards County

A prospective extension of the Parkersburg field of Richland County, Martin et al 1 Deischer, E½ NW SW 26-2n-10e, proved disappointing last week when water ruined the hole at a total depth of 3,268 ft. The test, about 4 miles southwest of present production in the field, recovered 7 ft. of fair McClosky pay at 3,260 ft. Although dry, it will probably bring other tests to the area in the near future as a result of the recovery of McClosky pay.

Despite the failure of 1 Deischer the Parkersburg field was extended southwest into Edwards County by one of the outstanding completions of the week. The extension well, Central States Pipe Line 1 Kent, E½ SE NE 31-2n-14w, came in flowing naturally and made an actual production run of 1,505 bbl. during the first 24 hours. Three locations have been started around the test and the area will be linked with the Parkersburg field within a short time.

New Pools in Prospect for Clay and Richland Counties

The prospective pool opener in Richland County, Nolf et al 1 Nuding, NW SW NW 6-4n-14w, is still not producing after swabbing 1,000 bbl. from the McClosky but failing to flow. The well will be placed on pump and should make a good producer. A north offset, Nolf et al 1 Sterchi heirs, has set surface casing.

Another pool was in sight for Clay County west of Xenia where the Carter Oil Co. is testing the Aux Vases sand at 1 Keller, W½ SW SW 4-2n-5e, which is showing for light production. The test was dry in the McClosky.

Perry County Wildcat Fails in Benoist

Although G. H. Blankenship 1 Herbert George, NW NE SW 23-4s-1w, wildcat near Tamaroa in Perry County, proved disappointing on a drill-stem test of the Benoist, its importance did not diminish. During a 45-minute drill-stem test of the Benoist at 1,247-72 ft., 250 ft. of salt water with a showing of oil and gas was recovered. The test is now being drilled to the Aux Vases and oil men believe the prospects in this formation to be good with a possibility in the Rosiclare or McClosky if the test is taken that deep. The Aux Vases is expected 70 to 90 ft. below the Benoist.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: Benton	3	530	6,380
Clay City	4	304	12,288
Johnsonville	14	12,541	44,871
Louden	6	1,362	16,941
New Harmony	5	1,206	14,189
Rising Sun	3	72	6,527
Rural Hill	4	1,550	13,237
Walpole	4	1,113	12,372
Woodlawn	4	935	7,880
Other pools	22	2,595	53,197
Wildcats	2	1,594	6,272
Gas wells: Russellville	1	*6.5	1,073
Dry holes: Fields	†12	.....	32,192
Wildcats	10	.....	26,261
Total	94	.....	253,680
Recompletions	15	1,333	.....

*Million cu. ft.

†Clay City 1, Johnsonville 6, Keensburg 1, Louden 1, Mount Carmel 1, Omaha 1, Posey 1.

ILLINOIS COMPLETIONS

Wildcats

Clay County: Lain O. & G. 1 Aldrich, N½ NE SE 26-4n-5e, dry at 2,838 ft., Menard 2,034 ft., Glen Dean 2,218 ft., Barlow 2,392 ft., Cypress 2,404 ft., Weller 2,425 ft., Paint Creek 2,539 ft., Benoist 2,593 ft., Renault 2,655 ft., Aux Vases 2,669 ft., Ste. Genevieve 2,717 ft., Fredonia 2,752 ft., McClosky 2,830 ft.

Burhans 1 Bryan, E½ SW NW 36-5n-7e, location abandoned.

Douglas County: Ill.-Midcont. 1 J. Bragg, NE NW NE 33-16n-9e, dry at 700 ft.

Edwards County: Menafee 1 McDowell, S½ SE NE 31-1n-11e, dry at 3,299 ft., Tar Springs 2,503 ft., Tar Springs sand 2,518 ft., Glen Dean 2,641 ft., Hardinsburg 2,656 ft., Barlow 2,844 ft., Cypress 2,851 ft., Cypress sand 2,864 ft., Paint Creek 2,972 ft., Benoist 3,002 ft., Renault 3,080 ft., Aux Vases 3,098 ft., Aux Vases sand 3,150 ft., Ste. Genevieve 3,204 ft., McClosky 3,245 ft., St. Louis 3,282 ft.

Central Pipe Line 1 Kemp-Stremme, E½ SE NE 31-2n-14w, flowed 1,504 bbl., McClosky 3,116-23 ft., T.D. 3,123 ft.

Franklin County: E. S. Adkins 1 Whaley, SE SW SE 35-5s-2e, dry at 2,904 ft., base Pennsylvanian 1,686 ft., Menard 1,962 ft., Vienna 2,091 ft., Tar Springs 2,122 ft., Golconda 2,312 ft., Barlow 2,455 ft., Paint Creek 2,595 ft., Benoist 2,600 ft., Renault 2,663 ft., Aux Vases 2,706 ft., Rosiclare 2,768 ft.

Smokey Oil 1 Thomas, SW NE NE 1-6s-2e, dry at 2,903 ft., Menard 1,978 ft., Vienna 2,108 ft., Tar Springs 2,158 ft., Glen Dean 2,204 ft., Hardinsburg 2,250 ft., Golconda 2,335 ft., Barlow 2,485 ft., Cypress sand 2,508 ft., Paint Creek 2,613 ft., Renault 2,697 ft., Aux Vases 2,735 ft., Ste. Genevieve 2,755 ft., McClosky 2,880 ft.

Carter 1 U. S. Coal & Coke, SW SE NW 20-6s-4e, dry at 3,265 ft., base Pennsylvanian 2,132 ft., Waltersburg 2,224 ft., Waltersburg sand 2,245 ft., Tar Springs 2,297 ft., Glen Dean 2,428 ft., Hardinsburg 2,478 ft., Barlow 2,660 ft., Cypress sand 2,700 ft., Renault 2,885 ft., Aux Vases 2,982 ft., Ste. Genevieve 3,036 ft.

Jasper County: Texas 1-B Hines, W½ SW NE 7-6n-10e, dry at 2,861 ft., Glen Dean 2,306 ft., Golconda 2,397 ft., Cypress 2,465 ft., Cypress sand 2,520 ft., lower Paint Creek 2,645 ft., Benoist 2,653 ft., Renault 2,695 ft., Aux Vases 2,729 ft., Ste. Genevieve 2,780 ft., McClosky 2,840 ft.

Marion County: C. C. Nye 1 H. M. Long, W½ NW NW 27-3n-4e, dry at 2,684 ft., Menard 1,856 ft., Waltersburg 1,928 ft., Waltersburg sand 1,949 ft., Vienna 1,996 ft., Tar Springs 2,010 ft., Glen Dean 2,075 ft., Hardinsburg 2,102 ft., Golconda 2,144 ft., Barlow 2,232 ft., Cypress 2,252 ft., Benoist 2,394 ft., Renault 2,436 ft., Aux Vases 2,462 ft., Ste. Genevieve 2,504 ft., Fredonia 2,518 ft., McClosky 2,578 ft.

Richland County: R. B. Martin 1 J. Deischer, NW SW 26-2n-10e, dry at 3,331 ft., Menard 2,407 ft., Waltersburg 2,472 ft., Vienna 2,580 ft., Tar Springs 2,586 ft., Tar Springs sand 2,599 ft., Glen Dean 2,656 ft., Hardinsburg 2,673 ft., Hardinsburg sand 2,683 ft., Golconda 2,749 ft., Barlow 2,838 ft., Cypress 2,550 ft., Weller 2,891 ft., Paint Creek 3,000 ft., Benoist 3,025 ft., Renault 3,098 ft., Aux Vases 3,106 ft., Aux Vases sand 3,180 ft., Ste. Genevieve 3,204 ft., McClosky 3,257 ft., St. Louis 3,327 ft.

Ohio 1 M. Lambert, S½ SE NW 17-2n-14w, pumped 90 bbl., 9 per cent water, 2,500 gal. acid, McClosky 3,124-26 ft., 3,137 ft., T.D. 3,149 ft.

Shelby County: McFarland 1 Cozalet, SE SE SE 6-12n-2e, dry at 1,476 ft., base Pennsylvanian 1,110 ft., Glen Dean 1,173 ft., Golconda 1,245 ft., Cypress sand 1,370 ft., Paint Creek 1,391 ft., Benoist 1,427 ft., Renault 1,452 ft.

Williamson County: 1 John Flemming, NE SE NW 9-10s-2e, location abandoned.

Fields

Albion, Edwards County: Superior 4 J. Fewkes, SW SE SW 7-2s-11e, pumped 22 bbl., 82 per cent water, McClosky 3,102-10 ft., T.D. 3,115 ft.

Allendale, Wabash County: Patton Oil 3-A Stilwell, N½ SW NW SW 27-1n-12w, location abandoned.

Seaboard 1 C. Stevens, NW SW NE 16-1n-12w pumped 20 bbl. in 20 hr., 10-qt. shot 2,113-19 ft., Benoist 2,111-18 ft., T.D. 2,352 ft., P.B. 2,119 ft.

Beane & Boyer 1 S. H. Price, SW NW NE SW 2-1n-12w, pumped 6 bbl., Bridgeport sand 1,120 ft., T.D. 1,603 ft., P.B. 1,180 ft.

Allendale, Lawrence County: C. Evarts 2 Spidel, NE NE NW 26-2n-12w, pumped 83 bbl., Biehl 1,370 ft., T.D. 1,401 ft.

Bartelso, Clinton County: Newton & Ward 5 Gross, S½ SW NE SW 5-1n-3w, pumped 30 bbl., 10-qt. shot 987-97 ft., Cypress sand 980 ft., T.D. 999 ft.

Benton, Franklin County: Adkins 3 Orient "M", NW NW NW 31-6s-3e, location abandoned.

Adkins 4 C. W. & F. "W", SW NW SE 36-6s-2e, pumped 190 bbl., 40-qt. shot on bottom, Tar Springs 2,088 ft., T.D. 2,122 ft.

Adkins 11 C. W. & F. "W," SE NW SE 36-6s-2e. pumped 210 bbl., 40-qt. shot 2,096-2,119 ft., Tar Springs 2,064 ft., T.D. 2,126 ft.

Adkins 2-A McKemie, SW NW SW 30-6s-2e, pumped 130 bbl., 20-qt. shot 2,121-32 ft., Tar Springs 2,115 ft., T.D. 2,132 ft.

Bonpas West, Richland County: Ohio 2 Whittaker, W½ NW SE 8-2n-14w, location abandoned.

Bridgeport, Lawrence County: Ulom et al 1 Barnett, NE NW NW 8-2n-11w, pumped 13 bbl. oil and 50 bbl. water, 1,500 gal. acid, ripped casing 1,828-48 ft., 2,110-18 ft., 2,382-92 ft., Ste. Genevieve 1,817 ft., Fredonia 1,825 ft., St. Louis 1,926 ft., Salem 2,320 ft., T.D. 3,440 ft., P.B. 2,402 ft.

Centralia, Clinton County: J. McNeil 3 Knolhoff, NE SW SW 11-1n-2w, pumped 6 bbl., 20-qt. shot 1,172-82 ft., Cypress sand 1,172-82 ft., T.D. 1,182 ft.

Clay City, Wayne County: Pure 1 Ulm, E½ SW NE 1-1n-7e, pumped 81 bbl., 5,0000 gal. acid, McCloskv 3,045-49 ft., T.D. 3,052 ft.

Pure 3-B Harrington, E½ NE SE 11-1n-7e, pumped 51 bbl. oil and 5 bbl. water, 5,000 gal. acid, McClosky 3,067-70 ft., 3,083-91 ft., T.D. 3,101 ft.

Pure 1-B Benskin, N½ NW SE 31-2n-8e, pumped 83 bbl. oil and 2 bbl. water, 5,000 gal. acid, McCloskv 3,020-27 ft., T. D. 3,030 ft.

Pure 2-A Hasselton, E½ SW SE 28-2n-8e, pumped 89 bbl., 5,000 gal. acid, McClosky 3,015-20 ft., 3,055-60 ft., T.D. 3,105 ft.

Clay City, Clay County: Regent Oil 1 Trotter, SE SE SW 29-3n-8e, dry at 3,100 ft., Glen Dean 2,531 ft., Barlow 2.698 ft., Cypress 2,715 ft., Weller 2,720 ft., Benoist 2,910 ft., Benoist sand 2,914 ft., Ste. Genevieve 3,019 ft., McClosky 3,060 ft.

Dale, Hamilton County: Pure 20 Cuppy, NW NW NW 7-6s-7e, pumped 180 bbl., 310-qt. shot 2,967-3,015 ft., Aux Vases 2,963 ft., T.D. 3,015 ft.

Dundas, Jasper County: Pure 2 J. Benefield, S½ NW NW 9-5n-10e, pumped 87 bbl., 5,000 gal. acid, McClosky 2,775-82 ft., 2,790-95 ft., 2,802-05 ft., T.D. 2,815 ft.

Walsh & Dye 1 Haynes-Sutton, SW SE SW 5-6n-10e, pumped 64 bbl. oil and 64 bbl. water, 5,000 gal. acid, McClosky 2,798-2,806 ft., T.D. 2,808 ft.

Dupo, St. Clair County: R. F. Loveridge 3 Gaskill, SW NW NW 34-1n-10w, pumped 120 bbl. oil and 400 bbl. water, 1,000 gal. acid, Trenton 672 ft., T.D. 732 ft.

Goldengate, Wayne County: J. Chevigney 1 Shaffer, W½ NE SE 30-2s-9e, pumped 50 bbl., 20-qt. shot 3,241-57 ft., Aux Vases 3,238 ft., Aux Vases sand 3,251 ft., T.D. 3,382 ft., P.B. 3,351 ft.

Griffin, Wabash County: Longhorn 23 Helm, S½ SW SE NE 22-3s-14w, pumped 255 bbl., 50-qt. shot on bottom, Benoist 2,632-55 ft., T.D. 2,655 ft.

Johnsonville, Wayne County: Olson Drlg. 2 Oglesby-Hopkins, E½ NE NW 3-1s-6e, flowed 420 bbl., 5,000 gal. acid, perf. 3,142-69 ft., McClosky 3,145-48 ft., 3,156-62 ft., T.D. 3,231 ft., P.B. 3,178 ft.

Shell 1 H. Galbraith, S½ SE SW 22-1n-6e, flowed 1,934 bbl. in 23 hr., 5,000 gal. acid, McClosky 3,117-26 ft., 3,131-37 ft., T.D. 3,191 ft.

Texas 2 J. Bullard, E½ NW SE NW 22-1n-6e, location abandoned.

Olson Drlg. 1 C. B. Clay, S½ NW SE 35-1n-6e, dr at 3,378 ft., Glen Dean 2,586 ft., Barlow 2,759 ft., Cypress sand 2,794 ft., Benoist 2,933 ft., Renault 3,039 ft., Aux Vases sand 3,045 ft., Ste. Genevieve 3,112 ft., Fredonia 3,183 ft.

Hoosier Drlg. 1 Clsne, dry at 3,220 ft., Glen Dean 2,532 ft., Renault 3,036 ft., Aux Vases sand 3,041 ft., Ste. Genevieve 3,081 ft., McClosky 3,142 ft.

O'Meara et al 1 Evans, N½ NE SW, 23-1n-6e, dry at 3,252 ft., Golconda 2,705 ft., Barlow 2,814 ft., Aux Vases 3,077 ft., Ste. Genevieve 3,152 ft., Rosiclare 3,170 ft., Fredonia 3,195 ft.

Texas 1 J. Bullard, S½ SE NW 22-1n-6e, dry at 3,290 ft., Glen Dean 2,607 ft., Golconda 2,684 ft., Cypress 2,794 ft., Aux Vases 3,070 ft., Ste. Genevieve 3,122 ft., McClosky 3,189 ft.

Shell 2-A Clsne State Bank, E½ SW SE 22-1n-6e, dry at 3,065 ft., lost tools at 3,065 ft., junked hole.

United Prod. 2 J. H. Porter, E½ SE SE 36-1n-6e, pumped 269 bbl., 1,000 gal. acid, perf. 3,220-22 ft., 3,226-32 ft., 3,242-54 ft., McClosky 3,220-22 ft., 3,226-32 ft., 3,242-54 ft., T.D. 3,277 ft.

United Prod. 1 George Watson, N½ SW NE 35-1n-6e, pumped 186 bbl., perf. 3,162-64 ft., 3,174-80 ft., McClosky 3,162-64 ft., 3,166-71 ft., 3,174-81 ft., 3,193-98 ft., T.D. 3,208 ft.

United Prod. 4 Cariens, N½ NW SW 35-1n-6e, flowed 363 bbl., 3,000 gal. acid, perf. 3,145-48 ft., 3,157-63 ft., 3,181-84 ft., McClosky 3,145-55 ft., 3,157-63 ft., 3,181-84 ft., T.D. 3,205 ft.

Wiser 1 Hall, S½ NW SE 33-1n-6e, flowed 700 bbl., 5,000 gal. acid, perf. 3,142-50 ft., 3,156-64 ft., McClosky 3,142-64 ft., T.D. 3,217 ft.

Shell 3 G. W. Wilson, S½ NE SE 33-1n-6e, flowed 755 bbl., 3,000 gal. acid, McClosky 3,127-35 ft., 3,136-38 ft., 3,141-44 ft., T.D. 3,204 ft.

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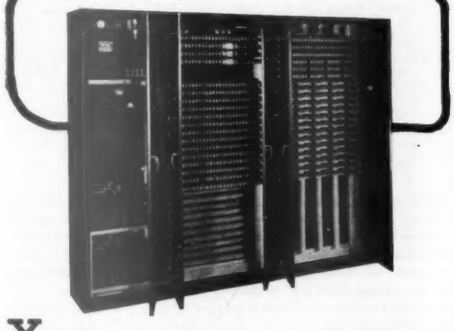

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Texas 4 Schultz, N½ NE NE 28-1n-6e, flowed 1,341 bbl., natural, McClosky 3,128-37 ft., T.D. 3,223 ft.

Texas 1 Schultz, S½ SE SE 28-1n-6e, swabbed 161 bbl., 3,000 gal. acid, McClosky 3,078-83 ft., T.D. 3,121 ft.

Ohio 2 P. Leathers, N½ SE SW 26-1n-6e, pumped 144 bbl., 3,000 gal. acid, McClosky 3,139-43 ft., T.D. 3,243 ft.

Ill.-Midcont. 1 Watson-Wells, S½ SW SE 26-1n-6e, flowed 1,946 bbl., 3,000 gal. acid, McClosky 3,118-29 ft., 3,140-44 ft., T.D. 3,144 ft.

Wiser 1 T. E. Hilliard, flowed 2,000 bbl., 5,000 gal. acid, perf. 3,110-66 ft., McClosky 3,149-68 ft., 3,174-76 ft., T.D. 3,192 ft.

Texas 1 Wilson, SW NE SE 22-1n-6e, flowed 672 bbl., 3,000 gal. acid, McClosky 3,166-74 ft., T.D. 3,200 ft.

R. O. Smith 2 Greathouse, S½ SW SE 22-1n-6e, flowed 1,650 bbl., 5,000 gal. acid, McClosky 3,131-41 ft., 3,146-50 ft., T.D. 3,215 ft.

Wiser Oil 2 Vaughan, W½ NE NE 1-1s-6e, dry at 3,318 ft., Glen Dean 2,596 ft., Barlow 2,809 ft., Aux Vases sand 3,103 ft., Ste. Genevieve 3,169 ft., Fredonia 3,208 ft., McClosky 3,237 ft.

Keensburg, Wabash County: Continental 4 Cowling, NE SE SW 7-2s-13w, pumped 403 bbl., perf. 2,760-67 ft., McClosky 2,760-67 ft., T.D. 2,798 ft.

Knight 1 Hoffman, W½ SW NW NE 29-2s-13w, dry at 1,760 ft., Biehl 1,754 ft.

Louden, Fayette County: Carter 2 J. Bragg, NW NE NE 16-8n-3e, flowed 306 bbl., 20-qt. shot 1,506-12 ft., Cypress sand 1,505 ft., T.D. 1,514 ft.

Carter 7-D Boles, NW SW 21-8n-3e, flowed 250 bbl through ½-in. choke, Devonian 3,016 ft., pay 3,097 ft., T.D. 3,098 ft.

Carter 3-D M. Durbin, NE NE 28-8n-3e, flowed 176 bbl. oil and 44 bbl. water, perf. 3,002-06 ft., 1,000 gal. acid, Devonian 2,927 ft., pay 3,007 ft., T.D. 3,037 ft., P.B. 3,025 ft., drilled out to 3,032 ft.

Carter 1-D Mable Mills, SE SW 28-8n-3e, flowed 130 bbl. in 12 hr. through ⅝-in. choke, 100 gal. acid, Devonian 3,012 ft., pay 3,094 ft., T.D. 3,095 ft.

Carter 13-D M. Mills, W½ SW SW 28-8n-3e, flowed 250 bbl. through ⅝-in. choke, 100 gal. acid, Devonian 2,970 ft., pay 3,056 ft., T.D. 3,057 ft.

Carter 3-D Wetmore, SW NW 11-8n-3e, flowed 250 bbl. through ½-in. choke, Devonian 3,050 ft., pay 3,135 ft., T.D. 3,140 ft.

Jarvis & Marcell 1-D Yakey, E½ NW SE 6-7n-3e, dry at 3,262 ft., Glen Dean 1,264 ft., Ste. Genevieve 1,673 ft., Devonian 3,045 ft.

Maud, Wabash County: Magnolia 2 E. Alka, NW SE SW 34-1s-13w, pumped 35 bbl. oil and 35 bbl. water, perf. 2,638-48 ft., 2,000 gal. acid, Rosiclare 2,639-47 ft., 2,659-62 ft., 2,689-93 ft., T.D. 2,700 ft.

Mill Shoals, White County: H. H. Weinert 7 Miller-Anderson, SW NE NE 30-3s-8e, pumped 300 bbl., 50-qt. shot 3,216-38 ft., 100-qt. shot 3,216-38 ft., Aux Vases sand 3,214-25 ft., T.D. 3,242 ft.

Mount Carmel, Wabash County: Bailor 5 Friend, SW SE NW 21-1s-12w, dry at 1,491 ft., Biehl 1,464 ft.

Dean & Morton 1 Hein, N½ SW SW NE 21-1s-12w, pumped 200 bbl., 80-qt. shot 1,458-78 ft., Biehl 1,458-78 ft., 1,482-94 ft., T.D. 1,993 ft., P.B. 1,478 ft.

Olds et al 1 School, SW NE SE SW 21-1s-12w, pumped 160 bbl., 15-qt. shot 1,984-94 ft., Cypress sand 1,984-94 ft., T.D. 1,994 ft.

New Harmony, White County: First Nat. Pet. Trust 6 Bump, NW SW NW 33-3s-14w, flowed 418 bbl., 3,000 gal. acid, McClosky 2,920-26 ft., T.D. 2,930 ft.

Mabee Oil 7 O. Smith, SE SW SE 4-4s-14w, flowed 173 bbl., 50-qt. shot 2,810-30 ft., Aux Vases 2,760 ft., T.D. 2,833 ft.

Magnolia 3 Cox, SW NE SE 5-4s-14w, pumped and flowed 325 bbl., 3,000 gal. acid, McClosky 2,892-2,906 ft., T.D. 2,928 ft.

Superior 2 Ford, SW NW SW 23-4s-14w, pumped 1?0 bbl., 6 per cent salt water, 40-qt. shot 2,651-60 ft., Cypress sand 2,646-60 ft., T.D. 2,660 ft.

Superior 16 H. E. Given, NE NE NW SW 34-4s-14w, pumped 180 bbl., 80-qt. shot 2,810-30 ft., 20-qt. shot 2,717-22 ft., perf. 2,564-96 ft., Cypress sand 2,564-2,613 ft., Benoist 2,704-46 ft., Aux Vases 2,809-29 ft., T.D. 2,838 ft.

New Haven, White County: Hiawatha 6 Stimson, NE NE NE 19-7s-11e, pumped 80 bbl., 25-qt. shot 2,450-60 ft., Cypress sand 2,444-60 ft., T.D. 2,463 ft.

Noble, Richland County: Pure 1 C. E. Lucas, SW NE NE 25-4n-9e, pumped 27 bbl., Barlow 2,535-50 ft., McClosky 2,927-32 ft., T.D. 2,992 ft., P.B. 2,560 ft.

Omaha, Gallatin County: Carter 2 L. Rister, SW SW NW 4-8s-8e, dry at 1,950 ft., Kincaid 1,370 ft., Clore 1,620 ft., Palestine sand 1,658 ft., Menard 1,714 ft., Waltersburg 1,806 ft., Waltersburg sand 1,816 ft., Vienna 1,854 ft., Tar Springs sand 1,921 ft., Glen Dean 1,932 ft.

Posey, Clinton County: Browning & Johns 1-A Lampen, NW NE NW 16-1n-2w, dry at 1,106 ft., Glen Dean 934 ft., Cypress sand 1,092 ft.

Rising Sun, White County: Cherry & Kidd 8 H. J. Karch, NW NW SE 13-6s-10e, pumped 10 bbl. oil and 70 bbl. water, Palestine 2,007-25 ft., T.D. 2,226 ft., P.B. 2,023 ft.

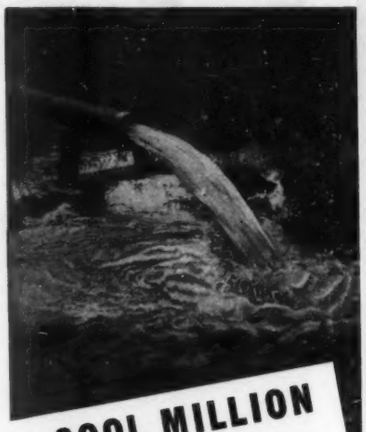
McElvain Bros. 2 Poole-Parr, S½ SW SW NE 13-6s-10e, pumped 17 bbl. oil and 80 bbl. water, 20-qt. shot 2,020-25 ft., Palestine 2,006 ft., pay 2,022-31 ft., P.B. 2,025 ft.

Magnolia 9 Sisson-Higgins, NE NW SW 24-6s-10e, pumped 45 bbl., 80-qt. shot 2,073-93 ft., 12-qt. shot 2,262-70 ft., Tar Springs 2,259 ft., Palestine 2,072 ft., T.D. 2,270 ft.

McElvain 1 Holderman, NE NE NW 13-6s-10e, dry at 2,975 ft., old well worked over, formerly completed as dry hole.

Roland, White County: Carter 1 L. D. Welch, SE SW SW 11-7s-8e, flowed 401 bbl. oil and 15 bbl. water, perf. 2,142-46 ft., Waltersburg 2,158-82 ft., T.D. 2,905 ft., P.B. 2,200 ft.

Rural Hill, Hamilton County: Magnolia 2 C. R. Sloan,



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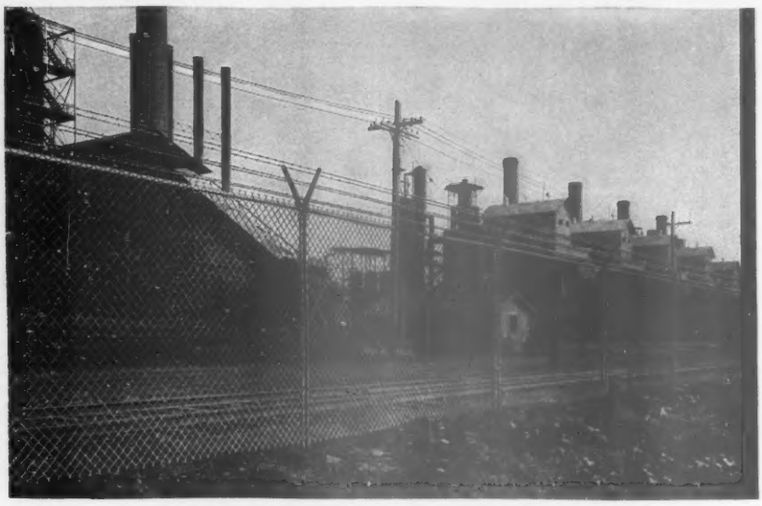

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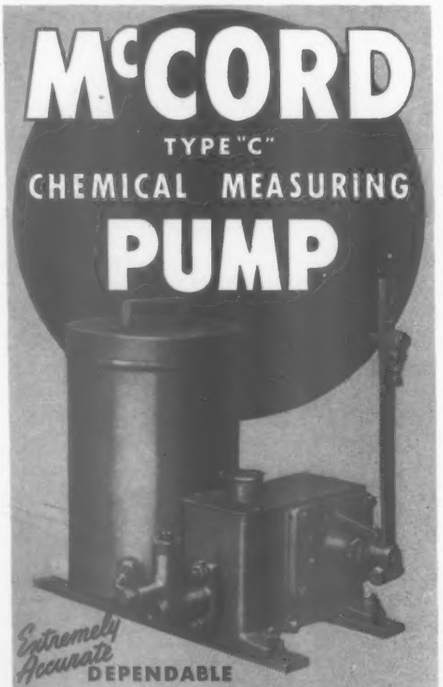

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NW SE NW 13-6s-5e, flowed 487 bbl., perf. 3,200-16 ft., 2,000 gal. acid, Rosiclare 3,193 ft., pay 3,202-16 ft., T.D. 3,410 ft., P.B. 3,318 ft.

Magnolia 3 C. R. Sloan, SE SE NW 13-6s-5e, flowed 800 bbl., Ste. Genevieve 3,176 ft., pay 3,186-96 ft., T.D. 3,385 ft.

Texas 1 T. Lockwood, NE SW NW 13-6s-5e, flowed 205 bbl., perf. 3,232-44 ft., 1,000 gal. acid, 30-qt. shot 3,171-80 ft., Aux Vases 3,160-76 ft., Rosiclare 3,232-44 ft., T.D. 3,320 ft.

Cameron 3 Lockwood, NE SE NW 23-6s-5e, pumped 58 bbl., 30-qt. shot on bottom, Aux Vases 3,084 ft., T.D. 3,122 ft.

Russellville, Lawrence County: Kentucky Nat. 3 Fischer et al, S½ SE NE 12-4n-11w, 6,500,000 cu. ft. gas, Buchanan 1,072 ft., T.D. 1,073 ft.

Sailor Springs, Clay County: Miller & Daubs 1 Palmer, SW NW SW 35-4n-7e, pumped 53 bbl. oil and 9 bbl. water, 20-qt. shot 2,604-09 ft., Cypress sand 2,602-10 ft., T.D. 2,610 ft.

Salem, Marion County: Texas 7 H. E. Corbin, S½ SW SE NE 31-2n-2e, pumped 92 bbl., natural, Trenton 4,463 ft., pay 4,485 ft., old well deepened from 3,335-4,590 ft.

Texas 14 L. Dunning, NE NW SE 31-2n-2e, pumped 70 bbl., Trenton 4,465 ft., pay 4,490 ft., old well deepened from 3,340-4,585 ft.

Texas 27 K. Wayman, SW SW NE 31-2n-2e, flowed 69 bbl., Trenton 4,465 ft., pay 4,485 ft., old well deepened from 3,369-4,586 ft.

Walpole, Hamilton County: Texas 1 Heck Comm., E½ NW SE 27-6s-6e, pumped 189 bbl., 40-qt. shot 3,068-95 ft., Aux Vases 3,053 ft., T.D. 3,095 ft.

Texas 3 O. Irvin, W½ NE SE 27-6s-6e, pumped 150 bbl., 20-qt. shot 3,070-90 ft., 40-qt. shot 3,070-90 ft., Aux Vases 3,050 ft., T.D. 3,095 ft., P.B. 3,090 ft.

Texas 4 O. Irvin, SE NE SE 27-6s-6e, swabbed 95 bbl., 30-qt. shot 3,070-91 ft., Aux Vases 3,048 ft., T.D. 3,093 ft.

Texas 1 McGill, N½ SE NE SW 27-6s-6e, swabbed 679 bbl., 30-qt. shot 3,067-87 ft., Aux Vases 3,048 ft., T.D. 3,089 ft.

Woodlawn, Jefferson County: Magnolia 1 Kamisle estate, NW NE SW 2-3s-1e, pumped 312 bbl., 40-qt. shot 1,942-58 ft., Benoist 1,935 ft., T.D. 1,961 ft.

Magnolia 2 Kamisle estate, NE NE SE 2-3s-1e, pumped 492 bbl., 60-qt. shot 1,927-58 ft., Benoist 1,908 ft., T.D. 1,958 ft.

Texas 2 E. A. Walker, SW SW NE 2-3s-1e, swabbed 49 bbl., 3-qt. shot 1,955-58 ft., Benoist 1,950 ft., T.D. 1,958 ft.

Magnolia 1 Rosa Rynski, W½ NE NE SE 34-2s-1e, pumped 9 bbl. oil and 8 bbl. water from Cypress, perf. 1,822-26 ft., old well P.B. from 1,925-1,920 ft., formerly salt-water disposal well. First Cypress producer in Woodlawn pool.

Texas 1 J. Bosenburger, SE NE NW 35-2s-1e, swabbed 85 bbl., 5-qt. shot 2,000-03 ft., Benoist 1,996 ft., T.D. 2,003 ft.

North Louisiana—Arkansas

(Continued from Page 205)

with original plans, the operators will start at once on 2 fee, another wildcat and located some 1½ miles to the northwest of the failure. Results of geological correlations between the two tests after the second has topped the Woodbine sand will determine whether one of the two will be deepened to the basal Glen Rose lime in search of deeper pay.

EAST TEXAS BORDER COMPLETION

Wildcat, Marion County: Dean Bros. 1 fee, B. F. Weatherred Survey, 11 miles west of Jefferson, top Woodbine 3,615 ft., dry at 3,663 ft.

Oklahoma Fields

(Continued from Page 201)

Okfuskee County: W. H. Allen 1 Camp, SE NE SW 18-11-10, 5½-in. 3,438 ft., bailing down.

John Droppleman 1 Wahola, NE NE SW 15-11-10, second Wilcox sand 3,942-46 ft., 10 bailers water an hour, P.B.

Oklahoma County: Harper & Turner 1 Yeager, SW SE NE 32-14-3w, drilling 6,250 ft.

Pontotoc County: W. A. Delaney 1 Norris, NW SW NE 3-3-6, Wewoka 320 ft., Wetumka 560 ft., Calvin 610 ft., Senora sand 730 ft., Senora lime 795 ft., Atoka 1,055 ft., drilling 1,805 ft.

Pottawatomie County: E. W. Young 1 Brown-A, NE SW NE 6-7-4, drilling 2,395 ft.

Kerlyn 1 Kirk, NW NE SW 1-8-4, Hogshooter 2,260 ft., Checkerboard 2,650 ft., Calvin 3,396-3,404 ft. and 3,457-61 ft., Hunton 4,101 ft., T.D. 4,165 ft., D.S. test 4,101-65 ft., open 30 min., show gas and 150 ft. oil-cut mud, to deepen.

Seminole County: Ramsey 1 Harjo, NW SE SE 24-6-6, Sylvan 3,880 ft., Viola 3,952 ft., dense 4,050 ft., dolomite 4,090 ft., Wilcox 4,152 ft., T.D. 4,174 ft. in Wilcox, electrical log, 4½-in. 2,308 ft., to test Calvin 1,565-1,601 ft. and Earlsboro 2,212 ft.

Donmar Oil 1 Smith, SE SE NE 29-8-6, perf. 4½-in. in Hunton 4,360-90 ft., flowed 60 bbl. a day pulled tubing and swabbed 200 bbl. in 18 hr., fishing swab.

Stanolind-Amerada 1 J. F. Buck, NW SE NW 11-10-7, pumped 117 bbl. oil in 19 hr. from second Wilcox 4,354 ft., testing.

Helmerich & Payne et al 1-A Williams, NW NW SE 16-11-8, T.D. 4,202 ft. in second Wilcox, swedged out pipe to 3,810 ft., could not get below 7-in. 4,051 ft., S.D.

Bornholdt-Welch Extended By Rice County Discovery

By ROBERT INGRAM

ANOTHER new pool was opened in Kansas last week. Like most of the other 31 discoveries of 1941, it was in an established producing area and looked like an extension in a large producing area. It was Aladdin Petroleum et al 1 Lackey, W½ SW SE 1-21s-6w, between the Bornholdt and Welch pools in Rice County. The well was given a potential of 278 bbl. a day from Mississippi chat at 3,366 ft.

The well topped the Mississippian at 3,337 ft. and had a show of oil from 3,341-46 ft. Four-inch casing was set at 3,338 ft. and plug was drilled out to 3,346 ft. with standard tools. At that depth it made about ⅓ bbl. oil in 10 hours. Crews shot from 3,342-46 ft. with 5 qt., had a show of oil, then cored to 3,348 ft. where fluid rose 700 ft. in the hole in 1¾ hours but was only 3 per cent oil.

SUMMARY OF COMPLETIONS

Kansas

	No.	Bbl.	Footage
Oil wells: Fields	12	20,156	36,368
Wildcats	2	113	4,575
Gas wells: Fields	3	1.2	1,680
Dry holes: Fields	5	.....	17,281
Wildcats	6	.....	20,632
Total	28	.....	80,536
Recompletions	3	4,168	.....

Nebraska

	No.	Bbl.	Footage
Oil wells: Wildcats	1	680	2,518

Fluid rose 100 ft. an hour in the hole after it was swabbed down and oil content increased to 10 per cent. It was then cored to 3,355 ft. where fluid rose 1,360 ft. in the hole in 22 hours. After another core was taken to 3,366 ft., fluid rose 3,000 ft. and was mostly oil. Operators then swabbed down to 700 ft. and swabbed 20 bbl. of oil an hour. Put on the pump, the well made 108 bbl. of fluid in 8 hours plus 11 per cent water. It was completed after this last test for an initial potential of 278 bbl.

The Bornholdt-Welch area, to which the new strike appears to be a southeast extension, now includes the Bornholdt, West Bornholdt, Welch and North Welch pools, all producing from the chat. This area, first opened at the Welch pool in April 1924, had 179 producing wells on July 1, last, and averaged 4,672 bbl. of oil a day production for the first 6 months of this year.

Ellis County Strike Does Not Meet Expectations

Falcon-Seaboard 1 Wasinger, NE SE 20-11-8w, a wildcat 4 miles west of the Burnett pool which looked like a discovery a week ago, was a doubtful producer after further testing last week. The well cored 4 ft. of saturated Arbuckle lime, topped at 3,514 ft., and found some oil after pipe was set. It was having trouble with water at week's end, however, and was swabbing very little oil.

Tests in McPherson and Reno Counties Draw Attention

McPherson County stood a good chance of getting a new oil pool at M. & L. Oil Co. and Jay Kornfeld 1 Johnson, W½ SW SE 7-17-3w. The well, which found good saturation and fair porosity from Viola lime at 3,347 ft., is about 1 mile west of the two wells producing in the Lindsborg pool. The Lindsborg wells are both Viola producers and are on the northeast side of the Barton arch which has had far less development than the opposite flank. Operators drilled 1½ ft. into the Viola before preparing to test.

In Reno County, Simpson Oil Co. 1 Paine, SW NW NE 5-24-10w, a wildcat between the Zenith and Peace Creek pools, was drilling through the Misener to test the Viola. Casing was set a week ago on top of the Viola at 3,834 ft. and, although a core of the Misener failed to show saturation, that zone was tested through perforations. When it failed to make a Misener well, operators prepared to drill ahead into the Viola with cable tools. This test was being watched with particular interest because of the strong belief that a link will be found between the Zenith and Peace Creek pools.

Four Wildcats Started During the Week

During the week four wildcats were staked—two in Pawnee County, one in Rusk County and one in Barton County. All are in a relatively new large area on the southwest flank of the Barton arch where development of such new areas as Pawnee Rock and Macksville has highlighted exploration.

In Pawnee County, Skelly Oil Co. staked 1 Yeager, W½ SW SW 32-22-15w, 7½ miles northwest of Macksville, and Stanolind Oil & Gas Co. located 1 Paramore, N½ SE 11-23-17w, 12 miles northwest of Macksville. In Rush County, Nelson Drilling Co. et al made location for 1 Folkerts, S½ SE NE 18-19-16w, near the Greenwalt area and northwest of Pawnee Rock. In Barton County, Continental Oil Co. 1 Eveleigh, SE SE NW 11-18-13w, was staked 4¼ miles southeast of the Hoisington pool.

KANSAS COMPLETIONS

Wildcats

Barton County: Aladdin Petroleum et al 1 Mull, N½ NW SE 2-20-15w, dry, T.D. 3,749 ft., anhydrite 901 ft., Fort Riley 1,935 ft., Topeka 2,975 ft. Lansing 3,308 ft., conglomerate 3,575 ft., Arbuckle 3,652 ft.

Elk County: McPherson et al 1 Clogson, SW SE SE 21-28-11e, pumped 5 bbl. oil and 10 bbl. water, gravity 33, Kansas City 1,062 ft., 6-in. 1,168 ft., pay 1,207-10 ft., T.D. 1,210 ft., *discovery.*

Graham County: R. W. Shields et al 1 Beveal, E½ SE NE 9-8-24w, dry, T.D. 4,319 ft., anhydrite 2,035 ft., Topeka 3,440 ft., Lansing 3,663 ft., conglomerate 4,140 ft., Mississippi 4,186 ft., Viola 4,291 ft.

Jefferson County: Longwell 1 Miller, SW SE 29-8-20e dry, T.D. 1,750 ft., base Hertha 818 ft., 8-in. 1,000 ft., McLeod 1,510 ft., Mississippian 1,544 ft.

Rice County: Aladdin Petroleum et al 1 Lackey, W½ SW SE 1-21-6w, pumped 108 bbl. fluid in 8 hr., potential 278 bbl. oil plus 11 per cent water, Mississippi lime 3,337 ft., 4-in. 3,338 ft., T.D. 3,365 ft., *discovery.*

Russell County: Helmerich & Payne et al 1 Jennrich S½ NW SE 13-12-15w, dry, T.D. 3,362 ft., anhydrite 852 ft., Topeka 3,680 ft., Lansing 2,937 ft., Arbuckle 3,347 ft.

Stafford County: W. O. Allen 1 Ersten, NE NW NW 7-22-14w, dry, T.D. 3,930 ft., anhydrite 780 ft., Topeka 3,125 ft., Lansing 3,477 ft., conglomerate 3,805 ft., Viola 3,818 ft., Simpson 3,871 ft., Arbuckle 3,912 ft.

Woodson County: W. R. Jenner et al 1 Hastings, E½ SE NW 24-26-13e, dry, T.D. 1,522 ft., Mississippi 1,478 ft.

Fields

Abbeyville, Reno County: Skelly 2 Linscheid, N½ SE NW 24-24-8w, pumped 14 bbl. oil and 46 bbl. water, Lansing 3,520-26½ ft., 5½-in. 3,530 ft., acid and shot, T.D. 3,548 ft.

Skelly 1 Linscheid-B, N½ NE NW 36-24-8w, dry, T.D. 3,602 ft., Lansing 3,207 ft., base Kansas City 3,596 ft.

Bemis, Ellis County: Cities Service 9 Colahan-B, NW SW NE 25-11-17w, pumped 3,000 bbl., Arbuckle 3,420-30 ft., T.D. 3,520 ft., P.B. 3,449 ft., acid and shot, 5-in. 3,250 ft.

Bloomer, Ellsworth County: Skelly 8 Agnes Moran, S½ N½ SE 31-17-10w, pumped 3,000 bbl., Arbuckle 3,231 ft., 4-in. 3,232 ft., acid, T.D. 3,239 ft.

Transwestern 4 Stumps, E½ SW SW 33-17-10w, dry, T.D. 3,294 ft., Arbuckle 3,262 ft.

Chase, Rice County: McPherson Drilling 3 Patton-B, NE SE SW 9-19-9w, pumped 3,000 bbl., Arbuckle 3,218 ft., 5-in. 3,218 ft., T.D. 3,220 ft.

Coralena, Russell County: Stanolind 2 John Letsch-A, N½ SW SE 4-15-13w, pumped 2,538 bbl., Lansing 3,012-76 ft., 5-in. 3,294 ft., acid and shot, T.D. 3,300 ft., P.B. 3,171 ft.

Dunaway, Greenwood County: Aikman, Acre and Derby Oil 8 R. W. Young, S½ E½ SE 22-22-13e, pumped 20 bbl., Burgess sand 1,807-17 ft., 5-in. 1,777 ft., T.D. 1,833 ft.

Eberhardt, Barton County: Vickers Petroleum 1 Herr estate, S½ SE NE 24-19-11w, pumped 3,000 bbl., Arbuckle 3,291 ft., 5-in. 3,292 ft., acid, T.D. 3,298 ft.

Eldorado, Butler County: Cities Service 206 Wilson, SE SE NE 8-25-5e, pumped 65 bbl. oil and 12 bbl. water, Kansas City lime 2,018-26 ft., acid, T.D. 2,035 ft.

Ferrell, Butler County: Table-Mesa Oil 7 Ferrell, SE NE SW 21-28-8e, pumped 50 bbl., Mississippi 2,734-35 ft. and 2,752-60 ft., 5-in. 2,732 ft., acid, T.D. 2,765 ft.

Hall-Gurney, Russell County: Cities Service 5 Ebel-B, N½ SE SE 24-14-14w, pumped 2,489 bbl., Lansing 2,889 ft., 5-in. 2,910 ft., T.D. 2,934 ft.

Stanolind 3 Krug-A, S½ S½ NE 27-14-14w, old well deepened from old T.D. 2,997 ft. in Lansing to T.D. 3,048½ ft., Lansing pay 3,042-48½ ft., pumped 607 bbl.

Skelly 2 Carter, N½ NE NW 33-14-13w, old well deepened from old T.D. 2,950 ft. in Lansing to T.D. 2,950 ft., Topeka 2,535-53 ft., pumped 61 bbl. oil and 60 bbl. water.

Kaths, Johnson County: Frederick J. Kasper 1 Walters, W½ SW SW 28-13-22e, gaged 140,000 cu. ft. of gas, Knobtown, T.D. 372 ft.

F. J. Kasper 1 Broadhurst, SE SE 29-13-22e, 325,000 cu. ft. gas, Lexington and Wheeler sand 520-32 ft. and lower Squirrel 630-47 ft., T.D. 653 ft.

F. J. Kasper 2 Walters, NE NE 32-13-22e, est. 750,000 cu. ft. gas, Wheeler sand 530-42 ft., lower Squirrel 639-54 ft., T.D. 655 ft.

Kraft-Prusa, Barton County: Black-Marshall Oil 1 Grossardt, NE NE NW 4-17-11w, pumped 2,955 bbl., Arbuckle 3,308 ft., acid, 5-in. 3,308 ft., T.D. 3,310 ft.

Rainbow Bend, Cowley County: Barnett Drilling et al 1 Thurlow, NW SW SE 17-33-3e, dry, T.D. 3,193 ft., Bartlesville sandy shale 3,178 ft.

Stoltenberg, Ellsworth County: Jack Robertson et al Malir, W½ NW NE 16-16-10w, dry, T.D. 3,350 ft., Lansing 2,990 ft., conglomerate 3,303 ft., no Arbuckle.

Trapp, Russell County: Shell 3-A Michaelis-B, E½ W½ SE 33-15-13w, pumped 25 bbl., Arbuckle 3,351 ft., 4-in. 3,351 ft., acid, T.D. 3,366 ft.

Zenith, Stafford County: Stanolind 3 Hays, SE SW SE 11-24-11w, old well deepened from old T.D. 3,777 ft. to 3,819 ft., Viola 3,776 ft., acid, flowed 3,500 bbl.

Cities Service 1 Kanatzer, N½ SW NW 18-24-10w, dry, T.D. 3,842 ft., Misener 3,800 ft., Viola 3,807 ft.

AVERAGE DAILY PRODUCTION

LEADING KANSAS FIELDS

	Nov. 1	Oct. 25
Augusta	1,250	1,250
Bemis-Shutts	11,950	10,850
Bloomer	5,750	6,150
Burnett	12,850	12,400
Burrton	7,000	7,500
Chase	3,950	6,850
Elbing	900	950
El Dorado-Towanda	7,250	7,000
Geneseo	5,750	7,250
Graber	2,900	3,050
Greenwood County	9,050	8,500
Hollow-Nikkel	1,400	1,350
Keesling-Midway	1,250	1,200
Lerado	900	450
Lorraine	600	1,450
Oxford	550	550
Rainbow Bend	950	900
Raymond	1,150	1,750
Ritz-Canton	3,750	3,700
Trapp	22,600	23,200
Balance Russell County	25,650	16,150
Sedgwick County	3,050	3,000
Silica	20,650	21,900
Voshell	1,650	1,700
Wellington	850	800
Wherry	1,200	2,550
Zenith	10,200	11,800
Others	72,350	81,300
Total Kansas	237,350	255,500

Second Producer at New Barada Pool Marks Discovery Anniversary

ST. JOSEPH, Mo., Nov. 3.—Nebraska, while celebrating November 1 as the second anniversary of the discovery of oil in the state, had a new well to talk about. It is Skelly 2 Roesch, second producer in the new Barada pool, 8 miles north of Falls City. The well flowed naturally at about 5 bbl. per hour from the Hunton lime, following perforation of casing. Skelly officials thought it might be possible to pump as much as 1,000 bbl. daily.

Elsewhere in Nebraska there was little activity because of mud and slush. Both rain and snow have made a quagmire of the area.

Buchanan County, Missouri, had the prospects of another dry hole at Ohio Oil Co. 1 Meek, some 11 miles due south of St. Joseph. The Cherokee system yielded no gas, the Mississippi lime had no breaks and nothing was showing in the Hunton as the drill was almost through that formation. It has been the most elaborate test in Missouri to date. A laboratory trailer analyzed mud through the Cherokee system.

In the McLouth pool of Jefferson County, Kansas, Ray Anderson 1 May Dick was showing for another oiler in the Bartlesville sand.

Seventy-One Producing Wells Drilled in Nebraska Pools

Nebraska's first oil was found by Guinn brothers, W. B. and B. G., who went from Odessa, Tex., to Nebraska to drill the well. Later they sold out to the Ohio Oil Co. Since then 55 producing wells have been drilled in the Falls City pool. Two wells have been drilled in the Dawson pool, 12 miles west; 12 in the

(Continued on Next Page)

TEXAS GULF COAST

Fred Prospect Wilcox Sand Opened for Fourth Discovery

By NEIL WILLIAMS

HOUSTON, Tex., Nov. 3.—The Fred prospect, southeastern Tyler County, was being added to the growing list of Wilcox sand pools along the Texas Gulf Coast district as Stanolind 1 J. F. Parker was cleaning out at the close of the week, flowing at the rate of 10 bbl. of fluid per hour through a ⅞-in. choke. Seventy per cent of the fluid was pipe-line oil and the balance was wash water. Tubing pressure was 185 lb., and casing pressure 760 lb. Total depth of the well is 8,500 ft., and production is through perforated casing opposite oil sand at 8,180-8,200 ft.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: Fields	13	1,751	80,670
Gas wells: Fields	1	.....	3,100
Dry holes: Fields	4	.....	20,002
Wildcats	6		45,200
Total	24	.....	148,972

The well is situated in the George T. W. Collins Survey, about 2 miles southwest of the Joe's Lake field, which produces from the Wilcox at 7,600-7,700 ft. This is the first test to be drilled by the company on the Wilcox trend, and it is the fourth field to be opened during the year. The other fields include Provident City, Lavaca County and Magnolia and Lake Creek in Montgomery County. In addition to these, another field is in the making at the Brushy Creek field, Lavaca County, where a wildcat is reported to be showing for a producer, but details of the completion were not available.

As the above well was being completed, several other wells along the trend were attracting attention. West of the Joe's Lake field, Republic Production Co. 1 Smith fee was plugged back from a total depth of 7,940 ft. to 3,994 ft., where the hole is being sidetracked due to a crooked hole. A survey showed the original hole to be located 18 ft. north and 182 ft. west of the surface location. Drill-stem testing the previous week at intervals from 7,683-7,706 ft. recovered some oil and salt water, and prospects of opening another pool for the county are encouraging due to the crooked hole which may account for the showing of salt water.

In the Lake Creek field, Montgomery County, Superior Oil Co. of California was preparing to retest 1-B McWhorter after the well flowed salt water with some distillate on a 7-hour drill-stem test through perforated liner at 11,595-11,605 ft. The well is reported to have tested 1,500-lb. working pressure and 786,000 cu. ft. gas. At the close of the week another test was being made at 11,730-45 ft.

Testing at this particular depth is somewhat of a surprise in view of the fact that 4½-in. liner was set on bottom at 13,330 ft., and a test of the interval from 12,000 to 13,000 ft. was expected. While the company's plans for testing have not been released, it is possible that the liner may be pulled and the hole deepened should the present tests fail. The well is situated about 2,000 ft. southwest of the company's 2-A McWhorter, which produces from the Wilcox at 9,769-79 ft. Stanolind 1 McWhorter, an offset to production is drilling in shale below 10,050 ft. An electrical survey showed nine sands at intervals from 8,840-9,732 ft., which is typical of the numerous sands logged in the two completed wells, both of which were drilled by Superior.

Grimes County Shallow Wilcox Area to Be Tested Again

In Grimes County, Oswego Oil Co. 1 Boney, a shallow Wilcox test located southwest of the town of Iola, is shut down for orders after the well flowed 10 bbl. of brackish water per hour when tested through perforated casing at 2,759-62 ft. Casing was cemented on bottom at 2,804 ft. after sidewall cores in the Wilcox showed possible production. Top of the Wilcox and details as to how much sand was logged have not been released by the company.

This particular area, located updip from the present Wilcox play, is receiving considerable attention and location for another wildcat was announced during the week. The well is Joe Ehlinger 1 Foster estate, located in the James B. Wilson Survey, Walker County. The location is several miles east of Cox & Ferrel 1 Foster estate, which has been shut down for several weeks at a total depth of 6,700 ft. An electrical survey is reported to have shown promise of production at intervals from 5,970-6,000 ft., and 6,118-36 ft., but no test has been made.

Two Tests Staked in New Magnolia Field

Locations were made for two interesting wells in the new Magnolia field, Montgomery County, by the Titanic Oil Co. The company is moving in material for 1 Nees, about 1,000 ft. south of the discovery well, while approximately 8,000 ft. southeast, location was made for 1 J. J. Parker in the C. Chilling Survey. Both wells will be drilled to a depth of 8,500 ft. or deeper to test the Wilcox sand at 8,448-58 ft. The discovery well, Glenn H. McCarthy 1 Sayle, completed in this sand several weeks ago, was officially completed for an initial production of 87 bbl. of distillate daily through a ¼-in. choke.

Big Hill Dome Flank Test Scheduled for 15,000 Ft.

On the northwest flank of the Big Hill dome, Jefferson County, Stanolind 1 George Anderson, T.&N.O. Survey 173, is bottomed at 8,550 ft., and an electrical survey was being made. An electrical log made from 6,250-7,011 ft. showed sand with resistance from 7,011-32 ft. and side-wall cores recovered shaly sand with an oil and gas odor. This well is said to be a projected 15,000-ft. test, and it is being drilled with one of the largest rigs ever assembled in the Gulf Coast district.

Wildcat South of Edna Is Testing

South of Edna, Jackson County, and located on strike with the Texana and North La Ward fields, J. L. Collins & Co. 1 H. Callaway, J. J. Linn Survey, was attracting considerable attention as it drills ahead in shale below 5,210 ft. The well topped the Discorbis at 3,343 ft., Heterostegina at 4,621 ft., and the round Marginulina at 4,651 ft. Two feet of sand with an oil odor was recovered in a core from 4,689-94 ft., while a small amount of sand with an oil odor was recovered in a core at 4,709-11 ft. Several drill-stem tests were attempted, but all failed when the seat failed to hold. Based on top of the Marginulina, the well is checking structurally higher than Sinclair Prairie 1 Vokner, located in the Texana field, several miles to the east.

TEXAS GULF COAST COMPLETIONS

Wildcats

Austin County: Woodley 1 Polschak, dry, T.D. 7,996 ft.
Brazoria County: H. E. Hamilton 1 J. M. Smith, dry, T.D. 7,010 ft.
Humble 1 R. L. Colley, dry, T.D. 9,545 ft.
Humble 1 Houston Farm Development Co., dry, T.D. 7,232 ft.
Fort Bend County: Jack Frazier 1 Mason and Andrew Briscoe, dry, T.D. 8,012 ft.
Polk County: Pan American 1 Goodrich, dry, T.D. 5,405 ft.

Fields

Anahuac, Chambers County: Humble 53 Middleton, dry, T.D. 7,323 ft.
Dyersdale, Harris County: Jack Frazier 4 Dwyer, 192 bbl., ¼-in. choke, perf. casing 4,050-75 ft., T.D. 4,080 ft.
Ganado, Jackson County: Texas 4 Mortgage Land & Investment Co., 180 bbl., ¼-in. choke, perf. casing 6,407-14 ft., T.D. 6,510 ft.
Hull, Liberty County: Gulf 116 Phoenix, 97 bbl. fluid, 90 per cent oil, 10 per cent salt water, pumping, T.D. 3,057 ft., P.B. T.D. 1,950 ft.
League City, Galveston County: Phillips 3 Rice estate, 164 bbl., ¼-in. choke, T.D. 8,750 ft.
Lolita, Jackson County: Cox & Hamon 2 Ten-Cate, 96 bbl., ¼-in. choke, perf. casing 5,944-49½ ft., T.D. 5,954 ft.
Humble 3 Mitchell, 432 bbl., ¼-in. choke, sand 5,275-88 ft.
Lovells Lake, Jefferson County: Humble 32 Broussard, 15 bbl., ⅛-in. choke, perf. casing 7,713-15 ft., T.D 7,723 ft.
Stanolind 5-A Steinhagen, 71 bbl., 3/32-in. choke, T.D. 7,800 ft., P.B. T.D. 7,788 ft.
Magnolia, Montgomery County: Glenn H. McCarthy 1 Sayle, 87 bbl., ¼-in. choke, perf. casing 8,448-58 ft., T.D. 10,008 ft.
Markham, Matagorda County: Hamill & Hamill 1 Meyers, dry, T.D. 3,553 ft.
Maurbro, Jackson County: Humble 3 Robbins, 432 bbl., ¼-in. choke, sand 5,212-17 ft.
North La Ward, Jackson County: Magnolia 1 W. H. Gordon, 80 bbl. 15 hr., ⅛-in. choke, perf. casing 5,214-22 ft., T.D. 5,235 ft.
Port Neches, Orange County: Phillips 9 Stark, 106 bbl., ⅛-in. choke, T.D. 3,550 ft., P.B. T.D. 3,403 ft.
Sabine Pass, Jefferson County: British American 1-C State, dry, T.D. 6,004 ft.
South Liberty, Liberty County: South Oil Co. 1 Chambers, dry, T.D. 3,122 ft.
Spanish Camp, Wharton County: Houston 3 Cloud, 20,000,000 cu. ft. gas, ⅝-in. choke, perf. casing 3,138-43 ft., T.D. 3,100 ft.
Van Vleck, Matagorda County: Skelly 25-C Cobb, 203 bbl., ⅛-in. choke, perf. casing 7,492-94 ft., T.D. 7,498 ft.

Ohio Fields

(Continued from Page 207)

T.D. 526 ft.
Preston Oil Co. 3E7 J. F. Grigsby, 5 bbl., Berea, T.D. 500 ft.
Hinckley Township: Harry Dempsey 1 Orin W. Charles, Lot 53, 6,500,000 cu. ft. gas, Clinton 3,362-77 ft.
Ohio Fuel 1 Frank Smith, Lot 72, 1,000,000 cu. ft. gas, Clinton, T.D. 3,518 ft.
A. Howells 1 W. J. Marquette, Lot 52, 300,000 cu. ft. gas, shot, Clinton, T.D. 3,596 ft.
H. C. Bishop 1 Arthur Hummel, Lot 75, dry, Clinton, T.D. 3,481 ft.
Spencer Township: Ohio Fuel 2 M. F. Aldrich, Sec. 11, dry, no Clinton sand, T.D. 2,730 ft.

Meigs County

Rutland Township: Bengal et al 2 Cora Morris, Sec. 31, 300,000 cu. ft. gas, M-800-ft. and Maxon sands, T.D. 863 ft.
Guy Swadley 3 fee, Sec. 31, 60,000 cu. ft. gas (Keener dry), T.D. 871 ft., old well deepened.
Salem Township: Utsinger et al 2 A. H. Hewitt, Sec 2, 130,000 cu. ft. gas, Salt sand, T.D. 625 ft.

Monroe County

Franklin Township: A. E. Robinson et al 1 William D. Hickels, SW Sec. 7, 5 bbl., Injun, T.D. 1,265 ft.

Muskingum County

Harrison Township: Pure Oil 1 Clarence Bibble, Sec. 14, 1,600,000 cu. ft. gas, Clinton 4,173-98 ft.
Madison Township: S. E. Large et al 1 Ella J. Long Sec. 19, 23,000 cu. ft. gas, plugged, Clinton 3,792-3,829 ft., T.D. 3,933 ft.
Salt Creek Township: Ohio Fuel Gas Co. 1 John O. Winters, SW Sec. 5, 14,000,000 cu. ft. gas, Clinton sand, T.D. 4,123 ft.

Noble County

Beaver Township: Chaseville Oil Co. et al 1 Charles P. Kronenbitter, NE Sec. 3, 2 bbl., Berea, T.D. 1,561 ft.
Ohio Fuel 2 W. H. Ankrom, Sec. 28, 60,000 cu. ft. gas, shot, Berea, T.D. 1,762 ft.
Elk Township: Metcalf 13 C. H. Masters, Sec. 22, 3 bbl., shot, Germantown, T.D. 1,023 ft.
Noble Township: Fassett & Harper 1 I. Boley, Sec. 17, dry, T.D. 195 ft.
Olive Township: Salt Run Oil Co. 1 Lee Davis, 1 bbl., shot, T.D. 264 ft.
Seneca Township: H. G. Clymer 1 Chester Bates, Sec. 36, dry, Berea, T.D. 1,605 ft.

Perry County

Clayton Township: Pure Oil 2 Edith Wilson, Sec. 8, 406 bbl., shot, Clinton 3,142-3,171 ft., T.D. 3,188 ft.
Preston Oil 1 Corynne Wagner, Sec. 4, 177 bbl., Clinton 3,335-45 ft., T.D. 3,396 ft.
Pure Oil Co. 3 W. C. Berry and R. E. Beard, SW Sec. 8, 238 bbl. and 50,000 cu. ft. gas, Clinton sand, T.D. 3,185 ft.
Abe Snyder et al 1 L. J. and G. Snyder, NW Sec. 22, 200,000 cu. ft. gas, Clinton sand, T.D. 3,270 ft.
Reading Township: Ohio Fuel 1 Jonah Miller, Sec. 5, 740,000 cu. ft. gas, Clinton 3,025-56 ft., T.D. 3,061 ft. (old well deepened from Berea).
Thorn Township: Davis et al 1 Charles Orr, Sec. 14, 1,300,000 cu. ft. gas, Clinton 2,771 ft., drilled 6 ft. in sand, T.D. 2,777 ft.
B. G. Davis et al 3 William Starkey et al, NW Sec. 13, 150 bbl., Clinton sand, T.D. 2,748 ft.

Tuscarawas County

Franklin Township: Columbia Carbon Co. 1 C. M. Wentling, Sec. 9, dry, Clinton 4,347-92 ft. and 4,420-68 ft., red rock 4,523-28 ft.

Vinton County

Eagle Township: Henderson Oil Co. 4 V. W. Thomas, Sec. 24, dry, shales, T.D. 1,045 ft.

Nebraska-Missouri

(Continued from Preceding Page)

Shubert pool, 8 miles north, and 2 in the Barada pool 8 miles north and east.

NEBRASKA COMPLETIONS

Wildcat

Richardson County: Skelly 1 Roesch, N½ NW 36-3n-16e, pumped 680 bbl. oil second 24 hr., gravity 30.1, Hunton 2,432 ft., 7-in. 2,516 ft., shot 2,443½-88 ft., T.D. 2,518 ft., *opens Barada pool.*

Permian Lime Strike Opens Third New Abell Area Pool

By D. H. STORMONT

MIDLAND, Tex., Nov. 3.—The most active area in the southern West Texas district last week was the northern part of Pecos County. A third new pool was showing in the Abell area, as operators renewed their investigation of the Ordovician and Permian sectors of the field. In addition, the South Apco pool was about to undergo an enlarged drilling campaign and a new wildcat test was staked west of Fort Stockton.

The new pool indicated for the Abell area was 3½ miles west and north of the Abell Permian pool and 4 miles east of the Abell Ordovician pool. The prospective discovery well is Stanolind 1 Rathjen, Lot 14, Section 26, Block 9, H.&G.N. Survey, which drilled broken pay from 3,850-3,950 ft. and on a 40-minute drill-stem test flowed at an estimated rate of 100 bbl. of oil per hour. The flow was through ½-in. choke, with gas volume at the end of the test estimated at 500,000 cu. ft. daily. Operator plans to run 7-in. casing before attempting completion. Production is from the Clear Fork section of the Permian lime and is equivalent to the Tubb pay in the western part of Crane County.

In the Abell Permian lime pool, east of the Ordovician field, Sinclair Prairie 1 Lutz is promising a small extension for the area, recently opened by Stanolind 1 Conry-Davis. During the week, I Lutz ran an electrical survey, which showed a maximum porosity from 3,935-50 ft. Operator cemented 7-in. casing at 3,990 ft. and, as the week ended, was drilling plug. The test is bottomed at 4,000 ft. No. 1 Lutz is east of Stanolind 2 Conry-Davis, producer in the pool, and is in NW SW SW Section 32, Block 6, H.&G.N. Survey.

SUMMARY OF COMPLETIONS

Southern West Texas

	No.	Bbl.	Footage
Oil wells: Foster	3	1,760	12,752
Goldsmith	2	1,320	8,455
Johnson	4	4,467	33,510
Keystone	4	1,265	13,896
North Cowden	2	1,239	9,115
Sand Hills	3	3,513	13,715
Waddell	1	1,486	3,500
Other fields	7	1,669	19,681
Wildcats	1	24	5,051
Dry holes: Fields	1	.....	3,581
Total	28	.....	123,356

Northern West Texas

	No.	Bbl.	Footage
Oil wells: Seminole	2	1,275	10,575
Slaughter	18	20,128	90,185
Other fields	4	2,002	12,625
Total	24	.....	113,365

Texas Panhandle

	No.	Bbl.	Footage
Oil wells: Fields	12	2,224	35,568
Gas wells: Fields	4	*64.6	13,540
Total	16	.....	49,108

Southeast New Mexico

	No.	Bbl.	Footage
Oil wells	6	222	5,317
Dry holes	1	.....	4,805
Total	7	.....	10,122

*Million cu. ft.

Completion at South Apco Extends Pool Quarter Mile South

A ¼-mile southwest extension to the South Apco pool appeared assured at the end of the week as Anderson-Prichard and Warner 3 Boren kicked off after a 1,500-gal. acid treatment to flow an unestimated amount of oil. Previously, 3 Boren had been plugged back from 4,956 ft. in granite to 4,865 ft. and had swabbed an average of 2½ bbl. of oil per hour during the last 6 hours of a 28-hour test through tubing. Location is 669 ft. from the east line and 659 ft. from the south line of Section 4, Block 605, Louisa Merchant Survey, a south offset to the same operators' 1 Boren, discovery well. The South Apco field is a south extension of the Apco-Warn r field.

Two other tests are drilling in the field. Anderson-Prichard and Warner 3 Masterson, Section 104, Block 10, H.&G.N. Survey, a northwest offset to the discovery, is drilling below 2,980 ft., while Superior Oil and Bryce McCandless 1 Crockett, Section 5, Block 110, T.C. Survey, is preparing to plug back. No. 1 Crockett topped the Ellenburger lime at 4,625 ft. and drilled to 4,851 ft. A 52-minute drill-stem test from 4,760-4,851 ft. recovered mud and sulfur water. Operators reportedly. are planning to plug back and test shows in the Ellenburger lime.

Pecos County Wildcat to Test Permian Lime

One wildcat test was announced for Pecos County during the week. Jamison & Pollard and Francis staked location for 1 University of Texas, 1¾ miles west of Fort Stockton. No. 1 University of Texas is 660 ft. out of the NE cor. of the SW of Section 34, Block 27, University Lands Survey. The test is contracted to 3,000 ft. unless production is obtained at a shallower depth. It will be drilled with cable-tool machinery.

Sand Hills South Outpost Is Plugged Back to Simpson

South of the south extension area of the Sand Hills field, Continental's wildcat, 1 Jones, was plugged back from 6,146 ft. in the Ellenburger lime to 6,015 ft. in the Simpson section. After recovering circulation oil, 1 Jones swabbed 36 bbl. of new oil through tubing in 5 hours. Operator is planning to treat the wildcat with acid.

In drilling, 1 Jones showed for production from the Simpson but was drilled deeper to test the Ellenburger lime, in which it found only sulfur water. Location is in Section 12, Block 3, H.&T.C. Survey, 1½ miles south of the extension area.

Deep Wildcat Staked in Terrell County

On a block of approximately 28,000 acres in central Terrell County, Skelly Oil Co. completed cellar and pits and is moving in cable tools for the immediate drilling of a scheduled 7,000-ft. wildcat. The test is 1 Ross Roberts, 660 ft. out of the NE cor. of Section 190, Block D, M.-K.-T. Survey, 16 miles northeast of the town of Sanderson.

Winkler County Test Will Try for Completion in Permian

As the week ended, operator at Magnolia 20 State-Walton, Section 4, Block B-3, P.S.L. Survey, scheduled Ordovician wildcat test in Winkler County, announced plans to attempt completion in the lower Permian lime rather than drill on to the Ellenburger as originally planned. At the present time, 20 State-Walton is bottomed at 8,445 ft. in chert, which has been classified as the Devonian by most of the geologists.

The wildcat is 1 mile east of the north end of the Kermit pool and 1½ miles west of the Keystone pool. In drilling, the test showed gas but no oil in the regular producing formations of either of these two pools. From 4,850 ft. to 7,525 ft. a series of intermittent shows were encountered. These were in the lower Permian. The top of the Devonian was logged at 7,620 ft.

As a result of the findings of two electrical surveys run in the hole, operator has decided to perforate opposite the Clear Fork horizon from 4,850-5,000 ft. If the test does show for commercial production, it will be completed without testing the other shows. If not, the other shows will be investigated in an effort to complete the wildcat for oil production.

Deep Andrews County Wildcat Tops Anhydrite

With elevation of 3,382 ft., Fullerton Oil Co. 1 H. M. Wilson, scheduled 8,000-ft. wildcat test in northwestern Andrews County, this week topped the anhydrite at 1,690 ft. This marker is 15 ft. low to Penn-Humble 1 Wilson, a failure 1½ miles southwest, and 5 ft. low to Hanagan 1 Logsdon, dry hole 2½ miles northwest. No. 1 Wilson is in the NE SW SE Section 15, Block A-32, P.S.L. Survey. At the end of the week, the wildcat was drilling below 3,000 ft. in anhydrite.

Oil and Gas Shows Reported in Yoakum County Wildcat

Two slight shows, one of oil and one of gas, were reported at Sinclair Prairie 1 C. J. Kleiner, Section 436, Block D, J. H. Gibson Survey, in Yoakum County. The wildcat, 3½ miles northwest of the Ownby pool, encountered a show of gas at 5,140 ft., with an increase at 5,160 ft. At 5,225 ft., the test drilled a slight show of oil, which was carried to 5,230 ft. However, operator continued to drill below 5,230 ft.

Wildcatting in Yoakum County received a setback this week with the failure of Honolulu Oil Corp. 1-13 Wright, Section 13, Block D, J. H. Gibson Survey. The wildcat had drilled to 5,390 ft. and was plugged with 3,500 ft. of salty sulfur water in the hole.

SOUTHERN WEST TEXAS COMPLETIONS

(24-hour rating based on last 3 hours of 6-hour gage)

Wildcat

Kenneth Slack 1 Pat Wilson, elev. 2,680 ft., 24 bbl. oil and 4 bbl. water, 150,000 cu. ft. gas, 90-qt. shot 5,023-43 ft., top Delaware 4,996 ft., T.D. 5,051 ft.

Fields

Abell, Pecos County: Phillips 1 Rixes, elev. 2,394 ft., 365 bbl., ½-in. choke, top Simpson 4,900 ft., pay 5,349 ft., T.D. 5,383 ft.

Crockett, Crockett County: Gilcrease 1-17 University, elev. 2,335 ft., 8 bbl., pumping, 30-qt. shot 1,437-47 ft., 500 gal. acid, pay 1,434 ft., P.B. from 1,467 ft.

Emperor, Winkler County: Texas 3-B Canden, elev. 2,815 ft., 260 bbl., 440-qt. shot 2,768-2,990 ft.

Foster, Ector County: Cities Service 2-B Bagley, elev. 2,967 ft., 260 bbl., pumping, 285-qt. shot 4,150-4,250 ft.

Forest Dev. 1-C Paul Moss, elev. 2,929 ft., 559 bbl., 522-qt. shot 4,081-4,240 ft.

Forest Dev. 14-H Paul Moss, elev. 2,931 ft., 941 bbl. 440-qt. shot 4,115-4,262 ft.

Goldsmith, Ector County: Gulf 373 Goldsmith, elev. 3,189 ft., 737 bbl., 4,000 gal. acid 4,168 ft., T.D. 4,253 ft.

Gulf 375 Goldsmith, elev. 3,138 ft., 583 bbl., 62-qt. shot 4,172-97 ft., T.D. 4,202 ft.

Johnson, Ector County: M. J. Delaney 7-A Johnson, elev. 3,007 ft., 385 bbl., 170-qt. shot 4,095-4,155 ft., T.D. 4,160 ft.

Sinclair 24-A Johnson, elev. 2,990 ft., 1,279 bbl., 290-qt. shot 4,080-4,150 ft., T.D. 4,160 ft.

Sinclair 22-D Johnson, elev. 3,035 ft., 1,453 bbl., 390-qt. shot 4,070-4,270 ft.

Sinclair 23-D Johnson, elev. 3,033 ft., 1,350 bbl., 290-qt. shot 4,090-4,165 ft.

Jordan, Ector County: Texas 6 McDonald, elev. 2,841 ft., 408 bbl., 980-qt. shot 3,395-3,705 ft.

Keystone, Winkler County: Gulf 43 Keystone, elev. 2,953 ft., 157 bbl., 365-qt. shot 3,375-3,471 ft., T.D. 3,481 ft.

Richardson Oil 1-A B. F. Jenkins, elev. 2,976 ft., 291 bbl., 1-in. choke, 320-qt. shot 3,376-3,477 ft., top anhydrite 886 ft., Yates 2,522 ft., T.D. 3,482 ft.

Richardson Oil 3 Keystone, elev. 2,974 ft., 574 bbl., 1-in. choke, 420-qt. shot 3,355-3,491 ft., T.D. 3,551 ft.

Standard 36-15 Baird, elev. 2,921 ft., 243 bbl., 270-qt. shot 3,275-3,382 ft.

Noelke, Crockett County: M. & M. 1-A Bouscaren, elev. 2,800 ft., 48 bbl., 3-in. casing outlet, pay 1,455 ft., T.D. 1,480 ft.

North Cowden, Ector County: Stanolind & Delaney 3-D Smith, elev. 3,037 ft., 181 bbl. oil and 14 bbl. water, pumping, 335-qt. shot 4,300-4,415 ft., T.D. 4,425 ft.

Texas 14 O. B. Holt, elev. 3,085 ft., 1,058 bbl., 540-qt. shot 4,410-4,690 ft.

North Ward, Ward County: Gulf 190 O'Brien, elev. 2,685 ft., 174 bbl., 400-qt. shot 2,596-2,685 ft., T.D. 2,689 ft.

Sand Hills (Permian), Crane County: Gulf 30 Waddell, elev. 2,630 ft., 1,159 bbl., 5,000 gal. acid, pay 4,570-75 ft.

Gulf 31 Waddell, elev. 2,628 ft., 1,883 bbl., 5,000 gal. acid, pay 4,525-70 ft.

Magnolia 7 Lea, elev. 2,630 ft., 471 bbl., 44/64-in. choke, 7,500 gal. acid, pay 4,453-4,570 ft.

Waddell, Crane County: Gulf 46 Waddell, elev. 2,767 ft., swabbed 3 bbl. oil following 195-qt. shot and 5,000 gal. acid 3,480-3,530 ft., dry at T.D. 3,681 ft.

Gulf 47 Waddell, elev. 2,764 ft., 1,486 bbl., 5,000 gal. acid 3,215 ft., T.D. 3,500 ft.

White & Baker, Pecos County: Cardinal Oil Co. 2-K White & Baker, elev. 2,981 ft., 106 bbl., 120-qt. shot 1,927-67 ft.

SOUTHERN WEST TEXAS ACTIVE WILDCATS

Crockett County: L. S. Pittman 1 Bouscaren, 467 ft. from N and W lines Sec. 29, Blk. HH, H.E.&W.T. Sur., 2,500-ft. test, drilling 1,470 ft.

Jacobs & Gibson 1 University Sur., Blk. 29, Sec. 5, 990 ft. from S and 990 ft. from E lines, drilling at 85 ft.

Amerada 1-G Todd Est., G.C.&S.F. Sur., Sec. 15, Blk. WX, 660 ft. from S and E lines, Ordovician test, moving in material.

Culberson County: John Wolfe 1 Wilson-Briggs, 2,316 ft. from N and 1,500 ft. from E lines Sec. 1, Blk. 112, W. N. Older Sur., fishing tools 425 ft.

El Paso County: J. S. Meriwether 1 Bodadilla, 660 ft. from N and W lines, Scrap File 254, setting 8-in. casing at 265 ft., T.D. 637 ft.

Ector County: Oil Well Drilling Co. 1 J. L. Johnson, T.&P. Sur., Blk. 44, Sec. 48, Twp. 1s, 467 ft. from N and 467 ft. from W lines, 4,500-ft. test.

Glasscock County: E. M. Wahlenmaier 1 Texas Ld. & Tr., 467 ft. from W and S lines Sec. 15, Blk. 34, T.&P. Sur., 3,500-ft. test, running 7-in. casing to 2,763 ft. to replace cable tools with rotary.

Irion County: B. C. Mann 1 M. Read, NE NE Sec. 2, Blk. 17, H.&T.C. Sur., drilling at 2,527 ft.

Pecos County: J. L. Cooper 1 University, SE SE SE Sec. 13, Blk. 16, University Sur., drilling 365 ft.

Cardinal Oil 1-3 University, 1,715 ft. from N and 2,370 ft. from W lines Sec. 3, Blk. 17, University Sur., set 10-in. casing at 457 ft., 7-in. casing at 1,300 ft., drilling at 1,377 ft.

Gulf 2 Millar, C NE SE Sec. 43, Blk. 11, Ordovician test, drilling 3,150 ft.

Reagan County: Amerada 1-RB University, NW NE Sec. 8, Blk. 48, University Land Sur., drilling 5,300 ft.

Amerada 1-RC University, SE NE Sec. 4, Blk. 48, University Land Sur., S.D. 2,790 ft.

Upton County: Plymouth 1 Alford, C Sec. 50, Blk. 12, P. B. Scott Sur., drilling 10,135 ft.

Ward County: Shell Oil 1 Sealy-Smith, 2,310 ft. from S and 330 ft. from E lines Sec. 38, Blk. A, G.M.M.B. &A. Sur., Ordovician test, drilling 7,100 ft.

Winkler County: Magnolia 20 States-Walton, NW cor. Sec., Blk. 3-B, P.S.L. Sur., S.D. 8,445 ft.

Sam Weiner 1 Halley, NW NE Sec. 7, Blk. 11-B, P.S.L. Sur., S.I. 3,023 ft.

NORTHERN WEST TEXAS COMPLETIONS

(24-hour rating based on last 3 hours of 6-hour gage)

Fields

Iatan-Denman, Howard County: Ennisbrook 2 Denman, 155 bbl. oil and 13 bbl. water, pumping 725-qt. shot 2,711-2,886 ft., old well drilled deeper.

Northwest, Mitchell County: F. W. Merrick 3-9 E. T. Strain, elev. 2,248 ft., 219 bbl., pumping, 540-qt. shot 1,640-1,762 ft.

R. J. Wallace 3 Foster, elev. 2,337 ft., 192 bbl., pumping, 305-qt. shot 2,742-2,842 ft., T.D. 2,862 ft.

Seminole, Gaines County: Amerada 8 Austin, elev. 3,335 ft., 535 bbl., ½-in. choke, 170-qt. shot 5,136-5,250 ft.

Amerada 13 Turlin, elev. 3,392 ft., 740 bbl., ½-in. choke, 180-qt. shot 5,204-5,325 ft.

Slaughter, Cochran County: Anderson & Prichard 2 Neal, elev. 3,678 ft., 459 bbl., 12,000 gal. acid, pay 4,908-49 ft.

Anderson & Prichard 5 Woodley, elev. 3,676 ft., 637 bbl., 10,000 gal. acid, pay 4,930-5,050 ft.

Anderson & Prichard 7 Woodley, elev. 3,688 ft., 1,085 bbl., 10,000 gal. acid, pay 4,926-79 ft.

George P. Livermore 13 Boyd, elev. 3,664 ft., 665 bbl., 10,000 gal. acid, pay 5,042-90 ft.

Slaughter, Hockley County: Honolulu 16-B Mallett, elev. 3,602 ft., 1,180 bbl., 2½-in. casing outlet, 10,000 gal. acid, pay 4,950-5,030 ft.

Magnolia 13-D Mallett, elev. 3,606 ft., 1,291 bbl., 10,500 gal. acid, pay 4,947-5,000 ft.

Magnolia 11-G Mallett, elev. 3,634 ft., 1,053 bbl., 3-in. casing outlet, 10,500 gal. acid, pay 4,941-5,004 ft.

Magnolia 13-G Mallett, elev. 3,608 ft., 1,415 bbl., 3-in. casing outlet, 10,500 gal. acid, pay 4,945-5,001 ft.

Magnolia 13-J Mallett, elev. 3,624 ft., 1,200 bbl., 2-in. casing outlet, 10,500 gal. acid, pay 4,983-5,040 ft.

Skelly Oil 1-B McRae, elev. 3,546 ft., 232 bbl., 12,000 gal. acid, pay 4,850-4,940 ft.

Texas 43 Slaughter, elev. 3,549 ft., 1,410 bbl., 12,000 gal. acid, pay 4,925-90 ft.

Texas 45 Slaughter, elev. 3,564 ft., 1,899 bbl., 12,000 gal. acid, pay 4,935-5,025 ft.

Texas 47 Slaughter, elev. 3,559 ft., 1,620 bbl., 11,000 gal. acid, pay 4,960-5,010 ft.

Texas 48 Slaughter, elev. 3,575 ft., 1,115 bbl., 12,000 gal. acid, 4,975-5,000 ft.

T.-P. Coal & Oil Co. 4-B Mallett, elev. 3,612 ft., 782 bbl. oil and 2 per cent water, 10,000 gal. acid, pay 4,970-5,030 ft.

Tide Water 5 Lincoln, elev. 3,571 ft., 967 bbl., 13,000 gal. acid, pay 4,871-4,985 ft.

Slaughter, Terry County: Honolulu 1-4 DeVitt, elev. 3,513 ft., 1,543 bbl., 10,000 gal. acid, pay 4,937-5,036 ft., T.D. 5,044 ft.

Honolulu 11 Frazier, elev. 3,514 ft., 1,570 bbl., 2½-in. casing outlet, 10,000 gal. acid, pay 4,910-5,018 ft.

Wasson, Yoakum County: Continental 6-867 Kendrick, elev. 3,575 ft., 1,436 bbl., 2-in. choke, 12,000 gal. acid, pay 4,995-5,115 ft.

NORTHERN WEST TEXAS ACTIVE WILDCATS

Bailey County: Broderick & Calvert 1 G. H. Hayward, 4,167 ft. from W and 1,389 ft. from S lines of Lge. 73, Sutton C.S.L. Sur., 5,500-ft. test, drilling 2,685 ft.

Borden County: Anderson-Prichard 1 Johnson & Clayton, Sec. 1, Blk. 1, John DeShanzo Sur., 660 ft. from SW cor. Sec. 23, Blk. 10, E.L.&R.R. Sur., 4,000-ft. test, drilling 3,794 ft.

M. L. Richards 1 W. R. Dunn, SW NE Sec. 307, Blk. 97, H.&T.C. Sur., 3,200-ft. test, running 7-in. casing, T.D. 2,854 ft.

Briscoe County: Phillips 1 Montague, NE NE Sec. 6, Blk. B-4, A.B.&M. Sur., drilling at 3,300 ft.

Cochran County: O'Neal Drilling Co. 1 Wright, NE cor. Lab. 12, Lge. 60, Martin C.S.L. Sur., 3 mi. N of Dean area, fishing at 4,983 ft.

Crosby County: George Callihan and C. L. Wager 1 E. M. Wahlenmaier, 460 ft. from N and E lines Sec. 3, Blk. D-15, Waxahachie Tap Sur., 3,200-ft. test, drilling 3,225 ft.

Dawson County: Ray Albaugh 1 Handley, SE SW Sec. 36, Blk. M, E.L. Sur., 5,250-ft. test, top Yates 3,050 ft., San Andres 4,580 ft., drilling plug, T.D. 4,977 ft.

Gaines County: Likins & Hall 1 Jones, SW NW Sec. 13, Blk. A-7, P.S.L. Sur., 7,200-ft. test, drilling 4,065 ft.

Lubbock County: Harrison & Foster 1 Steck, SE SE Sec. 7, Blk. A, J. Gibson Sur., 5,500-ft. test, stuck drill pipe 4,715 ft.

Lynn County: Trinity Drlg. Co. 1 Auld, 660 ft. from S and E lines of N½ SW Sec. O, Blk. T, Callison Sur., 5,200-ft. test, S.D., orders, 5,202 ft.

Mitchell County: H. B. Owenby Drlg. 1 Morrison Oil & Royalty, SE NE Sec. 34, Blk. 29, T.&P. Sur., 3,100-ft. test, drilling 2,545 ft.

H. D. McQueen and W. J. Donnley 1 D. Wulfjin, NE SW Sec. 5, H.&T.C. Sur., 3,000-ft. test, spudded and S.D.

Gibson Drlg. Co. 1 C. C. Thompson, Sec. 71, Blk. 27, T.&P. Sur., 933 ft. from N and 467 ft. from W lines, 300-ft. test, rigging up tools.

Wes-Tex Oil Co. 1 Jones, Sec. 22, Blk. 29, T.&P. Sur., 467 ft. from N and 2,173 ft. from E lines, drilling water well.

Terry County: American Drlg. 1 W. T. Hufnall, 467 ft. from E and S lines Sec. 14, Blk. D-14, C.&M. Sur., 5,500-ft. test, drilling 5,150 ft.

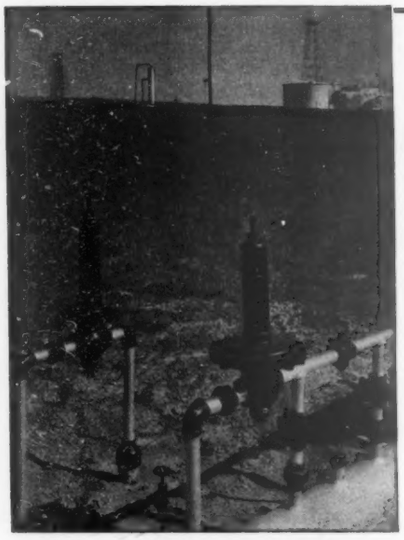
Yoakum County: Honolulu Oil 1-1e Wright, 467 ft. from N and W lines Sec. 13, Blk. D, J. Gibson Sur., 5,500-ft. test, top San Andres 4,560 ft., drilling 5,910 ft. with hole carrying 3,500 ft. of salty sulfur water.

Shell 1 M. L. Hammer, SW SW SW Sec. 490, Blk. D, J. Gibson Sur., P.B. to 5,351 ft. from 5,700 ft., 10,000 gal. acid, testing.

Motley County Wildcat Shut Down; New Test Staked

AMARILLO, Tex., Nov. 3.—Activity in the Panhandle district centered largely in the South Plains area with the staking of a new wildcat in Cottle County, and the shutting down of a second test in Motley County when it topped the granite. For the area as a whole, there were 24 new locations staked: 12 in Gray County, 11 in Hutchinson, and 1 in Potter County. Com-

(Continued on Page 224)



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West Hiawatha Gas Reserves Boosted by Deep Strike

By T. R. INGRAM

DENVER, Colo., Nov. 3.—The discovery of gas in a deeper horizon on the West Hiawatha structure in northwestern Colorado at Mountain Fuel Supply Co. 2 Lasher, NE NE NE 25-12n-101w, while not in large volume, makes another addition to that company's reserves for its trunk line into Utah. West Hiawatha adjoins East Hiawatha from which the company has been drawing a part of its supply for a number of years.

No. 2 Lasher was completed in gas zones at 2,905-17 ft. and 3,231-56 ft., which are the deepest horizons tested on the west dome. It is an offset to 1 Lasher, completed in 1929 at 2,160 ft. for 5,310,000 cu. ft. It was planned recently to carry this well on down to test lower horizons which produce oil on the east dome, but instead, a new hole was started from the surface.

SUMMARY OF COMPLETIONS

Wyoming

	No.	Bbl.	Footage
Oil wells: Fields	1	200	3,617

Montana

	No.	Bbl.	Footage
Oil wells: Fields	3	465	8,901
Dry holes: Fields	1	.....	1,460
Total	4	.....	10,361

The Mountain Fuel Supply Co. operates 530 miles of transmission lines and 871 miles of distribution lines in cities and towns extending to Salt Lake City and Ogden, Utah. Its supply is drawn from the Baxter Basin fields in Wyoming, the Hiawatha district, which straddles the Colorado-Wyoming boundary, the Powder Wash field in Colorado, and Clay basin, in Utah, all being in the same general area.

At the beginning of this year it had 43 wells connected to the transportation system. Its proven gas reserves are estimated to be adequate for the next 20 years. It has 29,736 acres of proven land and 56,711 acres of prospective acreage. Its market for gas has been showing a substantial increase, and it is reported that the company has been making investigations to determine the feasibility of installing a plant somewhere near the Utah terminals to store gas for use in an emergency or to augment its supply during peak demand by reducing it to a liquid through a freezing process. No official statement has been made, however, concerning these plans.

Mountain Fuel Supply 9 Florence Wilson, East Hiawatha, is a near completion at 2,841 ft. It is running casing to perforate and test sands at 2,764-87 ft. and 2,805-41 ft. On a drill-stem test the two sands showed for an aggregate of 9,000,000 cu. ft. Two upper sands showed oil.

Wildcat Southwest of Mahoney Logs Oil Shows in Frontier

Sinclair-Wyoming 1 Mary Carter, a wildcat on the Sherrard dome, 6 miles southwest of Mahoney dome, Carbon County, Wyoming, and in a general area where excellent wells are being drilled in the Tensleep formation, is reaching an interesting depth and has encountered shows of oil and gas in the Frontier sands. A tester set in the Frontier at 1,752-1,810 ft., open for 1½ hours, showed 1,000,000 cu. ft. of gas, and cores taken at 1,810-15 ft. showed oil saturation. The company has a unitized block of 11,000 acres, and the test is being drilled on a seismograph high.

Fourth Derrick to Be Built on Forty-Three-Year-Old Well

If oil wells had personality "Old 42" of the Continental Oil Co. in the Florence field in Colorado, could be very proud of its distinction as a long-time producer. It was completed in 1898, and is still pumping 6 bbl. a day and making enough gas to run the pump. It was drilled by the Florence Oil Co. and taken over by the Continental in 1910. Its early production records are not available. It has worn out three wooden derricks, and C. H. Rankin, Continental's superintendent of production, is preparing to erect a steel rig over it in the hope it will last for the remainder of the well's life. Another well in the field, No. 86, completed in April 1895, is still on production. Whether these wells hold any record is not known definitely, but they certainly are among the "old-timers."

Wall Creek Sand Test Staked On Big Pole Cat Structure

Yale Oil Corp. has made a location for an important wildcat to the Wall Creek at 3,200 ft. on Big Pole Cat structure, Park County, Wyoming. Contract has been let to Manning & Martin, Inc. Several wells have been drilled on the south end of the structure, but this location is on the upthrow side of a traverse fault which cuts the structure in the north part of Section 16, and was released following a detail survey by Geologist Irvine E. Stewart. The structure also is known as the North Byron, Danker and McMahom structure.

COLORADO DRILLING REPORT

Archuleta County: Navajo Oil Co. 1 Brooks, NE NE NW 2-32n-2e, spudded in 12½-in. hole, cable tools, to go to Dakota at around 1,100 ft., S.D. to complete rigging.

Huerfano County: Rheym & Tomkins 1 Two Pines, SE SE 31-28s-69w, drilling 1,206 ft.

S. W. Pressey 3 Alamo, SW SW NW 10-27s-68w, drilling 1,204 ft.

Kiowa County: Stanolind 1 Snell, C SW SW 7-20s-41w, derrick up, drilling 5 water wells.

La Plata County: E. B. Klem 1 Olbert, NW SW 9-35n-12w, T.D. 4,290 ft., fishing tools.

Las Animas County: Barney Oil 1 Dutto-Marchisio, NW NW 32-33s-62w, drilling 1,543 ft.

Logan County: Mutual Oil 1 State, C SW SW 32-7n-51w, T.D. 4,840 ft., P.B. to sand at 4,480-96 ft., shot with 2½ to 10 qt. at intervals, showing some gas, testing.

Moffat County: Texas 13 Knowlton, NW NW NW 10-4n-91w, drilling 4,524 ft.

Privett & Spangler 1 Stillings, NE SE SE 12-5n-96w, drilling 1,805 ft.

Great Divide Petroleum 1 Wyatt, NW NW SE 6-9n-92w, S.D. 1,850 ft., engine repairs.

C. R. Privett 1 Sutton, NE NE SW 1-5n-96w, T.D. 2,420 ft., straightening hole at 2,346 ft.

Mountain Fuel Supply 9 Florence Wilson, NE SE NE 22-12n-100w, T.D. 2,841 ft., cemented 7-in., will perf. and test gas sands at 2,764-87 ft. and 2,805-41 ft., showed for 9,000,000 cu. ft. on D.S. test.

Stanolind 19-M Parkinson, NW SW NE 22-4n-92, T.D. 3,539 ft., testing.

Stanolind 11-X Parkinson, CWL NE SE 22-4n-92w, spudded.

Rio Blanco County: Texas-California 8 Unit, NW SE NW 26-3n-9w, T.D. 750 ft., reaming.

United Oil Producers 1 Hill, Lot 13, 6-1n-101w, S.D. 1,300 ft.

Desert Oil Co. 1 Rector, Lot 6, 35-2n-102w, location.

United Producers 2 Hill, CEL Lot 13, 6-1n-101w, spudded.

Raven O. & R. 31 Government, CSL NW NE 31-2n-102w, T.D. 1,275 ft., standing.

Buford Oil Co. 1 Government, C SW SW 16-1n-91w, T.D. 4,527 ft., running tubing with packer to acidize and test.

Raven O. & R. 33 Government, NE SW NE 31-2n-102w, 35 bbl. per day at 570 ft., soon exhausted, deepened to 1,500 ft., standing.

Raven O. & R. 34 Government, SE NW NE 31-2n-102w, T.D. 1,554 ft., 75 bbl. first 24 hr. at 1,455-58 ft., soon exhausted, standing.

Raven O. & R. 35 Government, NE SW NE 31-2n-102w, standing 1,445 ft., show oil at 1,160 ft.

Routt County: Elk River Co. 1 Fred N. May, C SE SE 34-8n-86w, drilling 300 ft.

WYOMING COMPLETION

Oregon Basin field, Park County: Enalpac O. & G. 3 Sarah-O.P.C., NW SW SE 32-51n-100w, T.D. 3,617 ft., 5½-in. 3,571 ft., perf. 210 holes at 3,296-3,508 ft., pumped 220 bbl. first 24 hr., top Embar 3,258 ft., top Tensleep 3,554 ft.

WYOMING DRILLING REPORT

Carbon County: Continental Oil 1 Frank M. Johnson, SE SE SW 1-24n-88w, drilling 2,651 ft. in shale.

Sinclair-Wyoming 27-A Wertz, CSL NW SW 6-26n-89w, drilling 2,718 ft.

Ohio Oil 1 Union Pacific, NE NE 33-20n-81w, drilling 3,915 ft., top Wall Creek 3,452 ft.

Sinclair-Wyoming 26-A Wertz, NW SE SE 1-26n-90w (Sweetwater County), drilling 4,030 ft.

Sinclair-Wyoming 1 Mary Carter, NE SE SE 31-25n-88w, drilling 1,820 ft., show oil and gas in Frontier.

Sinclair-Wyoming 5-F Mahoney, C NE NW 34-26n-88w, drilling 4,440 ft., 7-in. at 4,344 ft., on top Tensleep.

Glen Swartout 3 Union Pacific, NE NE SE 21-22n-78w, T.D. 915 ft., underreaming 8-in. from 855 ft.

Sinclair-Wyoming 25-A Wertz, NW SE SW 6-26n-89w, drilling 4,850 ft.

Sinclair-Wyoming 25-C East Ferris, SE SE NW 25-26n-87w, T.D. 3,994 ft., P.B. to 2,850 ft. and set whipstock to redrill.

Fremont County: Continental Oil 3 Shoshone, CEL SE NE 1-6n-3w, T.D. 665 ft., S.I. for tankage, 500 ft. oil in hole from Tensleep at 395-665 ft.

Kirk Oil 6 Tribal, CNL NW SW 23-6n-2w, drilling 750 ft., 8¼-in. 437 ft.

Indian Oil 4 Tribal, SW NW NW 23-6n-2w, moving in.

Natrona County: Casper Creek Oil 1 State, SW SW NW 36-36n-81w, T.D. 2,640 ft., lowering 5⅛-in. for water shutoff.

Iba Dev. Co. 1, C NE SE 25-32n-82w, drilling 1,725 ft.

General Petroleum 75-17-G, NW NE SE 17-35n-77w, T.D. 4,609 ft., top Shannon 4,640 ft., installing pump.

General Petroleum 57-16-S, NW SW NE 16-35n-77w, drilling 2,300 ft.

K. S. Albert 1 Young, NE SE 25-32n-82w, T.D. 1,630 ft., cemented 5⅛-in. 1,590 ft., show oil.

Niobrara County: J. L. Berggren 1 fee, SE NW 23-35n-63w, drilling 2,780 ft.

Cow Gulch Oil 1 Nelson, C SE SW 19-35n-65w, drilling 3,905 ft.

Park County: Yale Petroleum 2-B Frisby, NE NE SE 32-52n-100w, T.D. 3,384 ft., installing pump.

Husky Refining 4-A Rosseau, NW SE SW 33-51n-100w, drilling 3,480 ft.

Stanolind 11-X Rosenberg, SE NE NE 26-58n-98w, T.D. 3,146 ft., top Embar 2,997 ft., Tensleep, 3,050 ft., swabbed 6 bbl. per hr., installing pump.

MacKinnie Oil & Drilling 1 Northern Pacific, CNL NW NW 5-57n-99w, drilling 2,450 ft. in Mowry shale, carrying 6⅝-in. at 2,350 ft., 1,000 ft. water in Frontier at 2,124-2,234 ft.

Enalpac O. & G. 1 Custer, NE NE SW 32-52n-100w, drilling 2,910 ft.

Yale Petroleum 2-A Mattie, SW SW NW 33-51n-100w, location.

Yale Petroleum 3-A Frisby, NE SW NE 32-52n-100w, location.

Continental 2 Northern Pacific-2, NW SW NE 23-58n-98w, drilling 775 ft., cemented 13-in. at 149 ft.

Yale Oil Corp. 1 Government, NW SE SW 9-57n-98w, location, test to Wall Creek, Big Pole Cat dome, first report.

Sublette County: Texas 2-I Government, SE NW SW 27-27n-113w, drilling 816 ft.

Sweetwater County: Sinclair-Wyoming 8 Hughes, SW SW SW 2-26n-90w, drilling 3,105 ft.

Farson O. & G. 1 Government, C SE NE 18-25n-108w, S.D. 1,822 ft.

Vermilion Oil 1 Government, SW NE NE 6-12n-99w, drilling below 2,300 ft.

MONTANA COMPLETIONS

Cut Bank field, Glacier County: A. B. Cobb 1 Jeffries-Stufft, CEL SE NE 3-35n-6w, T.D. 2,920 ft., 7-in. 2,896 ft., Sunburst sand 2,896-2,904 ft., swabbed 150 bbl. first 24 hr.

Par Oil Co. 1 Tribal-200, SE SW SE 13-32n-6w, T.D. 3,045 ft., 7-in. 3,010 ft., Cut Bank 3,010-45 ft., main pay 3,032-45 ft., swabbed 65 bbl. first 24 hr., then shot 100 qt., cleaning out.

Glacier Production 9 Bonnet, SW SE NE 4-32n-5w, T.D. 2,936 ft., Sunburst 2,820-85 ft., show oil 2,875-85 ft., Cut Bank 2,893-2,935 ft., main pay 2,922-35 ft., swabbed 250 bbl. first 24 hr.

Kevin-Sunburst field, Toole County: Montana-Dakota Utilities 329 Gypsy Parker, C SE NW 23-33n-2w, T.D. 1,460 ft., Sunburst 1,300-23 ft., dry, plugged and abandoned.

MONTANA DRILLING REPORT

Carbon County: R. C. Tarrant 2 McKay, C SE NW 4-6s-18e, resumed at 3,057 ft., drilling 3,680 ft. in Chugwater.

Fallon County: Carter 1 Northern Pacific, C SE SW 19-4n-62e, T.D. 9,678 ft. in schist at 9,654 ft., cemented 7-in. at 8,822 ft., will perf. and test sands at 8,620-8,740 ft., 8,490-8,540 ft., 8,310-60 ft., and 6,820-35 ft.

Mondakota Dev. Co. 3, C NE NE 36-5n-60e, drilling 500 ft. in Pierre shale.

Glacier County: Texas 10 Morrison, C S½ NW 22-35n-6w, drilling 570 ft., top Colorado 545 ft., 10¾-in. 557 ft.

William Hanlon 2 Tribal-196, SE NE NE 30-32n-5w, spudded.

Wilkinson & Potter 3 Tribal-126, C N½ NW 7-32n-5w, spudded.

Glacier Prod. 4 Rigney, SW SW NW 2-35n-6w, drilling 2,400 ft., top Colorado 640 ft.

R. C. Tarrant 3 Larson, C E½ NW 7-34n-5w, cemented 7-in. at 2,695 ft.

McDonald, Henderson, Overcash 3 Tribal-190, SW NE NW 29-32n-5w, spudded.

Par Oil 2 Tribal-204, NE NW SE 13-32n-6w, rig.

William Hanlon 3 Tribal-196, SW NW NE 30-32n-5w, rig.

Indian Oil 2 fee, C NW SW 4-34n-6w, rigging up.

Texas 4 Bonnet, CNL SW SW 8-32n-5w, spudded.

Texas 4 Willis, SW SE SW 18-32n-5w, spudded.

Texas 4 Lindquist, CNL NW 20-32n-5w, drilling 550 ft., top Colorado 450 ft., 10¾-in. 487 ft.

Texas 3-B Government, NE SW SE 18-32n-5w, drilling in at 2,680 ft., 1,400 ft. oil in hole.

(Continued on Page 223)

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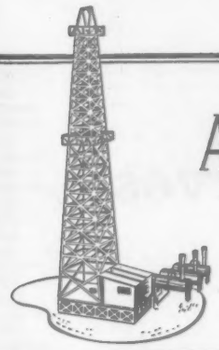


Among the Drilling

Vital Problems To Be Discussed At Contractors Annual Meeting

THE FIRST annual meeting of American Association of Oilwell Drilling Contractors, to be held in Dallas, Tex., November 13 and 14, comes at a time when pressing state and national problems are affecting the drilling industry at every turn.

Papers and addresses on the program have been prepared to give the drilling contractor a broader conception of operating conditions, plus a workable knowledge of national affairs.

The need for a united effort, a sound program and competent leadership is now more apparent than ever before, in the opinion of J. E. Brantly, of Dallas, Tex., association president.

Open sessions will be held on Friday, November 14. All directors and committeemen are urged to attend meetings on Thursday, November 13. Directors and committees will discuss such questions or problems as labor relations, wage and hour organization of local chapters, priorities, increase in membership, employes' welfare, transportation and highway laws, need for budgeting association expenses, drilling and contract form, compensation insurance, safety engineering, drilling practices, improvement in equipment, membership rates, accounting, railroad freight rates, policy, relation and cooperation with other associations, taxes and cable-tool drilling practices.

Drilling contractors annually complete more than three-fourths of the 25,000 to 32,000 wells drilled for oil and gas in the United States.

The petroleum coordinator's office recently announced that it is anxious to encourage wildcatting in all oil producing areas. The search for new oil reserves will continue, and systematic development of new fields will be carried out, under the OPC program repeatedly stressed by Coordinator Ickes.

The petroleum coordinator has stated that it will be necessary for equipment manufacturs to place oilfield equipment where it will do the most good, if upward of 30,000 wells are to be completed next year.

Next week's meeting will give drilling contractors a chance to become better acquainted and to exchange operating ideas on various districts. The program follows:

Thursday Morning, November 13, 1941
10:00 a.m.

1. Directors' meeting.
2. Meetings of all committees.

Friday Morning, November 14, 1941
9:00 a.m.

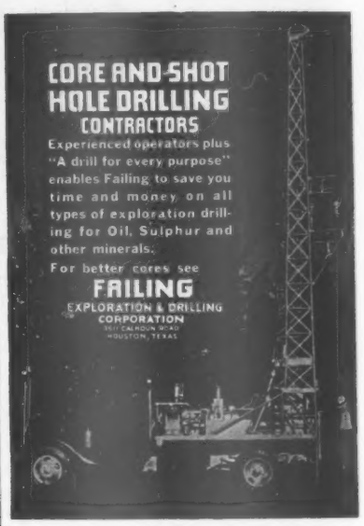
Harry L. Edwards presiding., Harry L. Edwards Drilling Co., Houston, Tex.

1. President's address: J. E. Brantly, Drilling & Exploration Co., Dallas, Tex.
2. The Contracting Industry, Its Past, Present and Future: Frank E. Stickle, Mabee Oil & Gas Co., Tulsa, Okla.
3. Trends in Drilling Machinery and Equipment: John M. Shimer, vice president Equipment Engineers, Inc., Dallas, Tex.
4. Drilling Practices: C. W. DeLancey, Humble Oil & Refining Co., Houston, Tex.
5. Accounting Practices: H. A. Pickens, McCamman, Morriss & Pickens, Fort Worth, Tex.
6. Contracting Personnel: Harry L. Edwards.

Friday Afternoon
2:00 p.m.

1. Principal speaker to be announced.
2. Insurance Compensation: B. F. King, Pacific Employers' Insurance Co., Houston, Tex.

J. E. Brantly, president of the American Association of Oilwell Drilling Contractors and head of the Drilling & Exploration Co., Inc., will preside at the organization's first annual meeting next week in Dallas, Tex.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3. Hidden Dollars on Accident Costs: R. C. Ledbetter, manager, safety department, Texas Employers' Insurance Association.

4. Cooperation Within the Industry: Joseph Zeppa, Delta Drilling Co., Tyler, Tex.

5. Business meeting.

Friday Evening

7:00 p.m.—Banquet

Toastmaster—to be announced.

Introduction and installation of new Officers.

Guest speaker: Col. Ernest O. Thompson, chairman, Railroad Commission of Texas, Austin, Tex.

Priorities and the Drilling Contractor: W. L. Childs, Reed Roller Bit Co., Houston, Tex.

GRACE & WOOD, Wichita Falls, Tex., were moving in rotary to the location for R. H. Hawn A-2 Dr. A. B. Edwards, a 5,250-ft. contract to be drilled 330 ft. from the north and west lines of a 160-acre lease out of Block 33, Lulu P. Hunt subdivision of Madison County school lands. The test is also 660 ft. north of the L. Edwards.

J. J. LONG, Shreveport, La., was reported to have taken contract to drill J. A. Hafner, Jr., 1 Nevils, for which location recently announced was 330 ft. out of the SE cor. of NE 10-7s-6w, 1½ miles northeast of Indian Village in Allen Parish, Louisiana. The location is on a block of some 6,000 acres assembled by Mr. Hafner.

HOUSH & THOMPSON, Houston, Tex., are contractors for a new wildcat in La Fourche Parish, Louisiana, in the north cutoff area some 5 miles east of Golden Meadow field. Location is in SE NW NW 32-18s-22e, objective is 7,500 ft.

OMOHUNDRO Drilling Co., Wichita Falls, Tex., has laid claim to a new record for a spudding machine at Hultz & Owen No. 1 well in Montague County. The well was drilled in at 7,239 ft., which depth exceeded by more than 1,000 ft. the previous record set by the same type spudder in 1939. The well site was 5 miles northwest of Bowie, Tex.

ED DE ARMAN, Tyler, Tex., has been awarded the contract to drill 1 C. E. Bogue as a 4,500-ft. test for Ownby Drilling Co. and E. L. Smith of Dallas. The well is in Van Zandt County nearly 5 miles southeast of Van, Tex., 1,650 ft. from the north line and 330 ft. from the west line of a 145-acre tract in the Marshall University survey.

OLSON DRILLING CO., Tulsa, has a Wilcox sand contract (about 5,500 ft.) for Skelly Oil Co. 1 I. R. Stewart, NE NW NE 2-13-2, a wildcat about 3½ miles south of Wellston in Lincoln County, Oklahoma, to be started as soon as weather permits.

MANNING & MARTIN, Denver, Colo., have the contract to drill a test to the Wall Creek sand at about 3,200 ft. on Big Pole Cat structure in Park County, Wyoming. Location is on the north side of a faulted zone which has been tested several times before to the south.

J. E. GRAGG, O. L. GRAGG, and M. C. ARNOLD recently formed the Arnold-Gragg Drilling Co., with offices in the Martin Building, Palestine, Tex. Mr. Arnold was formerly drilling superintendent with the W. B. Johnson Drilling Corp., Longview, Tex.

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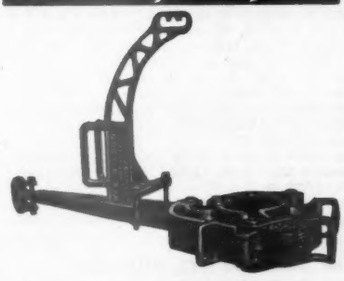

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Small Pumper North of East Texas May Revive Activity

By D. H. STORMONT

DALLAS, Tex., Nov. 3.—The eastern Texas district has completed its second week of intense wildcatting exploration. During the week, location was made for five new wildcat tests and blocks were being assembled for tests to be drilled at a later date. Four of the wildcats will test the Woodbine sand in Rains, Wood, Van Zandt, and Smith counties. The one exception will test the Wilcox in Trinity County.

About 1 mile northwest of Emory, E. Williams, Tom Hunter and A. Harvey have staked tentative location for a Rains County Woodbine wildcat. The test will be drilled near the center of the M. L. Scott 112-acre tract in the B. Johnson Survey. Williams has assembled approximately 5,000 acres in the area and plans to start drilling operation on or before December 1.

On a 7,500-acre block 5 miles northwest of Mineola in Wood County, derrick is being built for R. W. Fair 1 Boozer. The Woodbine sand test is contracted to 5,000 ft. It is located 467 ft. from the south and west lines of a 50-acre tract in the Daniel Fuller Survey. The block has been worked with geophysics.

In Van Zandt County, Ownby Drilling Co. has staked location for 1 C. E. Bogue, 1,650 ft. from the north and 330 ft. from the west lines of a 145-acre tract in the Marshall University Survey, Abstract 633. The test will be drilled on a block of approximately 4,000 acres. The Woodbine is expected around 4,000 ft. The location is 5 miles southeast of the Van pool and is on a structural high.

The Smith County wildcat will be drilled by Ryan Consolidated Petroleum Co. on the 3,981-acre D. L. Wright fee. Footage has been announced as 3,100 ft. south of the Sabine River and 12,812 ft. from the west line of the Jose Maria Garcia Survey about 4 miles south of Crow in Wood County. The wildcat will seek production from the Woodbine sand, expected around 4,800 ft.

Rig is being moved in at Magnolia 1 William Cameron & Co., scheduled Wilcox test in Trinity County. Location has been staked for the test 1,750 ft. from the south and 6,000 ft. from the east lines of the Henry Bond Survey. The site is in the southwestern part of the county and is about 3 miles northeast of the town of Glendale. Magnolia has acquired a large block in the area.

SUMMARY OF COMPLETIONS

	No.	Bbl.	Footage
Oil wells: East Texas fields	9	*408	32,571
Hawkins	6	1,620	29,008
Other fields	4	332	19,128
Dry holes: Wildcats	1		4,632
Total	20		85,339

*Hourly gage.

Small Pumper May Extend East Texas Field

The possibility of extending the East Texas field 3 miles to the north is being considered at a wildcat in Upshur County. Wrather & Wimberly have taken over 1 Webb estate from E. L. Baker and are planning to set pipe and complete the test as a small pumper. No. 1 Webb is in the E. S. McCullough Survey in the Glenwood area southeast of Gilmer. The completion of even a small pumping well in this area would undoubtedly open new play in the intervening area between the outpost and the field proper as well as stimulate exploration in the general area around the wildcat.

Hawkins Field Extended To the Southeast

A ¾-mile extension to the southeast and previous setbacks to the north are expected to initiate increased activity on the south and southeast edges of the Hawkins field. At the end of the week, Cable Tool Drilling Co. and O. J. Perrin completed 1 Laura Isaacs, H. F. Robinson Survey, ¾ mile southeast of the Hawkins townsite, in which there are several producers. No gage was announced but the extension well reportedly found 160 ft. of Woodbine sand pay section above 4,832 ft., total depth.

EASTERN TEXAS COMPLETIONS

Wildcat

Hunt County: Cable Tool Drilling Co. 1 Joe D. Williams, William Elama Sur., dry at 4,632 ft.

East Texas Field

(1-hour gage)

Joiner, Rusk County: R. E. Fair 19-A E. Maxwell, E. Collard Sur., 20 bbl., top Austin 3,530 ft., pay 3,700-18 ft.

R. E. Fair 21-A E. Maxwell, E. Collard Sur., 60 bbl., top Austin 3,525 ft., pay 3,680-3,721 ft.

Texas 15 L. J. Pinkston, J. B. Cadena Sur., 50 bbl., top Austin 3,450-3,590 ft., pay 3,626-50 ft.

Kilgore, Gregg County: Barnett Pet. Co. 8 Dickson & Saxon, M. V. Winkler Sur., 30 bbl., top Austin 3,470 ft., pay 3,535-60 ft.

Champlin & Bass 11 J. B. Watson, J. S. Carrithers Sur., 60 bbl., top Austin 3,495 ft., pay 3,570-90 ft.

Sinclair 68-A A. A. King, P. W. Warriner Sur., 60 bbl., top Austin 3,387 ft., pay 3,450-87 ft., T.D. 3,502 ft.

John Wrather 25-A I.&G.N., M. V. Winkle Sur., 50 bbl., top Austin 3,465 ft., pay 3,550-86 ft., T.D. 3,660 ft.

Longview, Gregg County: Tide Water 52 Lake Davernia, W. C. Painter Sur., 48 bbl., 2⅝-in. choke, top Austin 3,444-82 ft., pay 3,483-97 ft.

Longview, Upsher County: Texola and United 46-B Eva O'Byrne, J. M. Pineda Sur., 30 bbl., pumping, top Austin 3,607 ft., pay 3,672-75 ft.

Other Field Completions

East Long Lake, Anderson County: Tex Harvey 8 J. Cartmel, E. Ewing Sur., 85 bbl. in 24 hr., 7/64-in. choke, T.D. 5,417 ft.

Hawkins, Wood County: Humble 1 W. T. Minchew, J. B. Crain Sur., 316 bbl. in 24 hr., ¼-in. choke, top Austin 4,276-4,352 ft., Woodbine 4,540 ft., pay 4,652-4,921 ft.

Humble 2-A E. M. Slaughter, G. Brewer Sur., 102 bbl. in 6 hr., ¼-in. choke, top Austin 4,152 ft., Woodbine 4,412 ft., pay 4,640-4,852 ft.

C. L. McMahon, Inc., 2 E. Pouncey, S. Castleberry Sur., 90 bbl. in 6 hr., ¼-in. choke, top Austin 4,244 ft., Woodbine 4,466 ft., pay 4,524-4,720 ft.

C. L. McMahon, Inc., 3 L. H. Smider, J. R. Moseley Sur., 89 bbl. in 6 hr., ¼-in. choke, T.D. 4,842 ft.

Navarro Oil Co. 2 J. M. Greer, J. P. Moseley Sur., 99 bbl. in 6 hr., ¼-in. choke, top Austin 4,480 ft., Woodbine 4,616 ft., pay 4,743-4,850 ft.

Rudco Oil & Gas 1 W. Lowe, G. Brewer Sur., 119 bbl. in 6 hr., ¼-in. choke, T.D. 4,823 ft.

Long Lake, Anderson County: Tide Water-Seaboard 3 Frank Evans, John Adams Sur., 55 bbl. in 24 hr., 6/64-in. choke, 5,338 ft.

Pleasant Grove, Rusk County: L. O. McMillan 2 Strong & Pool, George May Sur., 12 bbl., 17 per cent salt water, T.D. 4,073 ft.

Talco, Franklin County: Humble 7 J. C. Young heirs. C. B. Zimpleman Sur., 82 bbl. in 4 hr., T.D. 4,300 ft.

EASTERN TEXAS ACTIVE WILDCATS

Franklin County: R. T. Meyers 1 F. J. Cox, 822 ft. from N and 624 ft. from E lines, J. M. Gill Sur., moving in rig.

Freestone County: Westbrook & Whistler 1 Coleman, H. Howard Sur., 2½ mi. SW Streetman, running 5½-in. casing, T.D. 3,463 ft.

Henderson County: British American Oil 1 Young, Joseph Rice Sur., 7½ mi. SW of Athens, flowing 16 bbl. oil and 21 bbl. water, 1,404,000 cu. ft. gas, reset packer 7,585 ft., tubing 7,618 ft., cleaning out hole.

Lone Star Gas 2 C. H. Allen, 3,490 ft. from W and 4,780 ft. from S lines, Lawson Sur., perf. casing, 8,421-29 ft., 8,571-78 ft., 8,584-90 ft., 8,628-36 ft., 8,642-50 ft., testing.

Hopkins County: W. B. Hinton & Talco Asphalt & Refg. 1 S. M. Long, 4,000 ft. from E and 650 ft. from S lines, W. Acquier Sur., drilling 4,420 ft.

Houston County: C. P. Culmore 1 G. T. Luncy, John Forbes Sur., 1½ mi. SE Lovelady, 467 ft. out of SE cor. of NE 40 ac. of 310-ac. tract, top Wilcox 2,100 ft., drilling 4,000 ft.

Hunt County: J. B. & Ed V. Parsons 1 O. P. Marshall, D. Ausmus Sur., E of Commerce, 475 ft. from N and 112 ft. from W lines of 100-ac. tract, waiting on cement, 218 ft.

J. D. Parsons 1 W. F. England, 330 ft. from N and 1,000 ft. from E lines, W. Marler Sur., building derrick.

Leon County: Hunt Oil Co. 1 D. A. Sullivan, F. Ramirez Sur., 467 ft. from S and E lines of 432.5-ac tract, rigging up.

J. R. Elliott 1 G. W. DeVaugh, Wm. Little Sur.,

930 ft. from SE and 467 ft. from SW lines, moving in material.

Limestone County: B. F. Weekly A-2 Barron, 660 ft. out of NE cor. 320-ac. tract in E. Mabry Sur., making ½ bbl. in 1 hr., 5,786 ft.

Zepher Oil 1 Barron, 337 ft. from NW and 300 ft. from SW lines, E. Mabry Sur., moving in material.

Robertson County: Cox & Bentley 1 Clark Kello, 1,140 varas from NW and SW lines, J. M. Bustilla Sur., 200 ft., waiting on cement.

Smith County: B. F. Phillips 1 J. C. McCormic, W. W. Avery Sur., 1,400 ft. from N and 467 ft. from W lines, Woodbine test, drilling 1,000 ft.

Wood County: R. W. Fair 1 W.,T. Boozer, D. T. Fuller Sur., 3 mi. north of Mineola, 467 ft. from S and W lines of 50-ac. tract, 467 ft. from N and E of Sec. of J. Crockett Sur., moving in material.

A. L. Andres 1 Henry, 467 ft. from N and E lines 140-ac. tract, J. Ewing Sur., drilling 3,050 ft.

Humble 1 J. C. Snow, 467 ft. from W and 2,250 ft. from N lines, J. B. Crain Sur., drilling 5,023 ft.

North Central Texas Fields

(Continued from Page 210)

5,000 ft., 2,000 gal. acid 5,039-58 ft., T.D. 5,130 ft.

Southern Pet. & Expl. Co., Inc. 5 L. F. Wilson, Sec. 73, Lot 1, A.T.N.C.L. Sur., 45 bbl. oil and 16 bbl. water in 9 hr., pumping, est. 85 bbl., 15-qt. shot 4,041-47 ft., pay 4,041-69 ft., T.D. 4,925 ft.

Jack E. Kadane 2-D E. P. Griffin, Sec. 14, Palo Pinto C.S.L. Sur., Abst. 339, 38 bbl. in 1 hr., ¾-in. choke, est. 275 bbl., pay 4,373-76 ft.

Clay County: George G. Golden 6 K. Enyart, Sec. 7, Thornberry subd., 25 bbl. in 24 hr., pumping, pay 1,117-26 ft.

Stayton Oil Co. 1 E. L. Turner, Sec. 55, Specht-McCutchen Sur., dry at 1,209 ft.

Akin, Dimock & Costley 2-A John C. Saner, Sec. 5, Pratt's Past. subd., 65 bbl. in 24 hr., pumping, pay 1,113-22 ft.

Jack County: John W. Campbell 5 C. A. Roach, William Berryman Sur., 4 bbl. in 24 hr., pumping, top Gunsight 458 ft., pay 495-503 ft.

Throckmorton County: Owenwood Pool No. 3 16 A. M. Housley, Sec. 28, Comanche Indian Reservation, 50 bbl. in 24 hr., pumping, pay 709-32 ft.

Owenwood Pool No. 3 17 A. M. Housley, Sec. 28, Comanche Indian Reservation, 30 bbl. in 24 hr., pumping, pay 715-31 ft.

A. L. Wasson 2 J. C. Erwin, Samuel Holder Sur., Abst. 212, dry at 816 ft.

Wichita County: Woody Drilling Co. and T. H. Peery 1 W. D. McClure, Sec. 5, C.C.&S.F. Sur., Abst. 363, dry at 1,675 ft.

Petroleum Inv. Co. 1-C L. P. Douglas, Sec. 24, L. M. Collins Sur., Abst. 399, 6 bbl. in 24 hr., pumping, pay 1,670-87 ft., old well drilled deeper.

Hanlon-Buchanan 9-A T. L. Burnett, Sec. 34, H.& G.N. Sur., Abst. 435, 10 bbl. in 24 hr., pumping, pay 721-29 ft.

Wilbarger County: Magnolia 34 W. T. Waggoner, Sec. 15, Blk. 13, H.&T.C. Sur., dry at 2,250 ft., Ellenburger 2,883 ft., 2,000 gal. acid, no result, old well drilled deeper.

Young County: Marie Echert 2 Gadberry, Sec. 227, T.E.&L. Sur., dry at 954 ft.

J. G. Wooten 1 D. L. Wolf, Sec. 283, T.E.&L. Sur., dry at 528 ft.

Paul Atchley 2 O. Deitrich, Sec. 196, T.E.&L. Sur., dry at 1,026 ft.

Brolon Producing Co. 2 S. P. Taylor, Sec. 1965, T.E.&L. Sur., 81 bbl. in 1 hr., est. 850 bbl., 5,000 gal. acid 4,000-10 ft.

Taubert & McKee 1 H. C. Shanafelt, J. Poitevent Sur., Abst. 1509, 15 bbl. in 24 hr., pumping, 3,000 gal. acid, pay 4,405-25 ft., P.B. 4,432 ft., T.D. 4,500 ft., old well drilled deeper.

Henry Zweifel, trustee, 1 P. K. Deats, M. Hull Sur., Abst. 1731, 62 bbl. in 72 hr., pumping, est. 25 bbl., 12,000 gal. acid, pay 4,447-63 ft., T.D. 4,535 ft.

NORTH TEXAS ACTIVE WILDCATS

Archer County: Phillips 1 Reilley, "Pendery," SW NW Sec. 13, Blk. 4, H.&T.C. Sur., 5,600-ft. test, S.D. 5,295 ft. for repairs.

Sunray Oil Co. 1 Seibold, 560 ft. from E and 330 ft. from S lines, L. P. Jones Sur., Abst. 939, Ellenburger test, top Caddo 4,722 ft., drilling 4,755 ft.

Dr. K. Van Allen 1 E. C. Kelley, 330 ft. from N and E lines, Sec. 68, Harris subd. of Club Ranch, 5,000-ft. test, drilling 3,580 ft.

Baylor County: Tom F. Hunter 1, Robertson C.S.L., 4,500 ft. from N and 460 ft. from E lines of Robertson C.S.L. Sur., Abst. 280, 3,500-ft. test, drilling 3,018 ft.

Clay County: Birdwell Oil 1 Myer (old well drilling deeper), Charleton Thompson Sur., Abst. 444, old T.D. 6,065 ft., working on pumping unit.

Continental 1 Spring, 200 ft. from N and 1,254 ft. from W lines, Sec. 24, M. True Sur., Abst. 1005, 6,500-ft. rotary test, moving in rig.

Shell 1-A J. W. Maddox, 2,272 ft. from N and 2,114 ft. from W lines of Hughes Sur., Abst. 179, 5,600-ft. rotary test, drilling 4,556 ft.

Shell 1 B. Williams, 330 ft. from N and W lines of E 60 ac., Sec. 63, J. H. Belcher Sur., 6,500-ft. rotary test, drilling 1,878 ft.

Sinclair 1 Scheer, 1,124 ft. from E and 330 ft. from S lines, Sec. 47, Orange C.S.L. Sur., Abst. 368, P.B. to 4,587 ft., attempting to make D.S. test, T.D. 6,459 ft.

Hunt Oil Co. 1 Longford Inv. Co., 719 ft. from N and 4,070 ft. from E of SE cor. of C. R. Henderson tract in R. R. Brown Sur., Abst. 14, 4,000-ft. rotary test, first report.

Superior Oil Co. 1-A G. W. Scaling, 2,600 ft. from N and 1,200 ft. from W lines of Sec. 2, H.&T.C. Sur., Abst. 882, 6,000-ft. rotary test, first report.

Cooke County: J. G. Richards & Son 2 J. Felderhoff, 800 ft. from E and 1,600 ft. from S lines, Lot 18-24, George Ivy Sur., Abst. 516, 760 ft., running 7-in. casing.

Bill Russell 1 Powers, 300 ft. from N and W lines of Powers tract, Hall Sur., Abst. 790, S.D. 1,304 ft., weather.

Thornton & McKee 1 Berryman, 450 ft. from N and 400 ft. from W lines, Sec. 22, Barnett Sur., 1,500-ft. rotary test, drilling 1,125 ft.

Denver Producing & Ref. Co. 1 Mattie C. Alred, 330 ft. from S and 990 ft. from E lines of Alred farm in Gaudelupe Santos Sur. (old well drilling deeper), old T.D. 4,582 ft., first report.

Denton County: Hunt Oil Co. 1 T. J. Jones, 4,300 ft. from S and 671 ft. from E lines of J. Thomas Sur., Abst. 1239, Ellenburger test, drilling 825 ft.

Foard County: Bruce Sullivan 1 McCoy, 467 ft. from N and W lines in J. M. Seaton Sur., 6,000-ft. rotary test, drilling 3,060 ft.

Jack County: Alma Oil Co. 1 Maxey, V. W. Maxey Sur., Sec. 2, drilling 5,648 ft.

Magnolia 1 Borden, 1,000 ft. from N and 500 ft. from W lines of W. R. Smith Sur., Abst. 547, Ellenburger test, P.B. 5,876 ft., waiting on cement, T.D. 6,026 ft.

Parker & Farris 1 Lewis, 467 ft. from S and W lines of E 80 acres, Blk. 2, Navarro C.S.L. Sur., Abst. 443, 30 ft., waiting on rotary.

Taubert & McKee 1 M. Hoefle, A. James Sur., Abst. 318, 4,835 ft., flowed 133 bbl. in 3 hr., ¾-in. choke on tubing after being S.I. several days.

Montague County: Benson Bros. 1 Riley, 467 ft. from S and midway between E and W lines of farm, C. Ellis Sur., Abst. 1146, 7,000-ft. rotary test, drilling 6,285 ft.

Chapman & McFarlin 1 Mose Fowler, R. M. Davis Sur., Abst. 181, S.I. at 4,937 ft., P.B. from 6,008 ft., T.D.

Continental 1 Winder, 467 ft. from N and E lines of S 40 ac. of W 80 ac. of N½ Sec. 4, Limestone C.S.L. Sur., 7,200-ft. rotary test, preparing for D.S. test 6,258 ft., T.D.

Youngblood, Foree & Stogner 1 C. D. Meador, 467 ft. from SE and SW lines, J. B. Miller Sur., Abst. 461, 6,000-ft. rotary test, drilling 150 ft.

Throckmorton County: Nash & Windfohr 1 Parrott, 660 ft. from S and W lines, Sec. 957 ft., T.E.&L. Sur., 4,500-ft. test, preparing to test, 4,017 ft., T.D.

J. W. Robinson 1 Benton Land Co., 150 ft. from E and 900 ft. from S lines of N 172 ac., Sec. 967, T.E.&L. Sur., first report.

Wilbarger County: Bruce Sullivan 1 Nattie Hamilton, 467 ft. NE line of Nattie Hamilton tract in Sec. 47, Blk. 12, H.&T.C. Sur., 4,700-ft. test, first report.

Young County: Kerlyn Oil and Phillips 1 E. C. Gravey, 947 ft. from N and 2,353 ft. from E lines, Sec. 4, O.B.&N. Sur., Abst. 19, 5,700-ft. test, drilling 3,711 ft.

Panhandle Ref. 1 Harrell, 467 ft. from S and E lines, G. N. Smith Sur., Abst. 254, 3,700-ft. rotary test, drilled plug at 3,570 ft., show of oil and gas, treated with 8,000 gal. acid.

Rocky Mountain Area

(Continued from Page 219)

Glacier Production 5 Corrigeux, C SW NW 28-33n-5w, location, first report.

R. C. Jeffries 2 Tribal-197, SW SW NW 30-32n-5w rigging up, first report.

Toole County: L. J. Yealy 16 Shaw, NW NW NE 35-36n-2w, T.D. 1,745 ft., 60-qt. shot, rigging to pump.

Montana-Dakota Utilities 327 Donovan, C NW SE 31-34n-1w, drilling 925 ft., 10-in. 220 ft.

Hat Oil 1 Mitchell, C NE SW 24-37n-3w, drilling 1,315 ft.

E. O. Reickhoff 1 Reickhoff, C NE SW 3-32n-2w, standing 60 ft.

J. H. Agen 18 Goeddertz, CSL NE SW 23-35n-3w, location.

Harmon & Morton 1 Sohn, SW SW NE 23-35n-3w, spudded to 60 ft. and S.D.

Nepstad Oil 3 Hugi, C SE NW 11-35n-3w, rig.

Casper T. Olen 12 Engermoen, NE SE NW 14-35n-2w, standing 1,661 ft. in Madison.

Big West Oil 1 Anderson, SW SW NE 12-35n-4w, drilling 2,160 ft., 8¼-in. 1,847 ft., gray dry sand at 1,965-2,025 ft.

A. A. Oil Co. 1 Fey, SW SE SE 32-37n-2e, drilling 1,610 ft., cemented 10-in. 289 ft.

Colonel Kevin Oil 10 Government, C NW NE 27-35n-3w, T.D. 1,705 ft., slight show oil would not respond to acid, will drill deeper, Ellis 1,693-1,703 ft.

Nepstad-Montgomery-Fargher 4 Haugen-2, CSL SW SW 2-35n-3w, T.D. 1,600 ft., fishing.

Dakota-Montana Oil 26 Government, CNL NE NW 19-35n-1w, standing rigged.

Gordon Plotke 4 Ward, SE SW SW 28-35n-3w, drilling 460 ft.

Superior Pet. 4-A Government C SE NW 24-35n-3w, drilling 1,520 ft., 5⅛-in. 1,507 ft.

Coolidge & Coolidge 1 Benjamin, C NW NW 9-33n-1w, drilling in Sunburst sand at 1,125 ft., top at 1,115 ft., showing for 1,000,000 cu. ft. gas.

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REGISTERED PROFESSIONAL ENGINEERS

Maryland Test Gets Small Gas Show From Oriskany

By STAFF CORRESPONDENT

PITTSBURGH, Pa., Nov. 3.—In Maryland the important wildcat drilling on the Schartzer (Humberson) farm on the Accident dome in Garrett County, topped the Oriskany sand at 8,082 ft. after an Onondaga chert section of 175 ft. At 8,096-97 ft. there was a showing of 12,000 cu. ft. of gas but at 8,097 ft. about 3 bbl. of water a day began to intrude. There was a black bituminous break in the sand at 8,092-93 ft. and it is drilling at 8,105 ft. without any increase in the water. The operators, New Penn Development Co., William E. Snee, believe this test entered the Lower Devonian on the downthrow side of a fault and the present depth is the bottom of the closure.

SOUTHWEST PENNSYLVANIA

On Chestnut Ridge in South Union Township, Fayette County, Peoples Natural Gas Co. topped the Oriskany sand at 6,774 ft. and is now drilling at 6,906 ft. in 5 Piedmont Coal Co. with no increase so far in the lower part of the sand. The gage is about 1,000,000 cu. ft. a day. In the No. 4, same lease, this company is drilling at 7,478 ft. and as yet the Onondaga has not been reached.

In Richhill Township, Greene County, Natural Gas Co. of West Virginia ran casing through the Fifth sand to 2,866 ft. in the deep test on the Andrew Workman farm and is now at 3,044 ft.

Armstrong County

Kiskiminitas Township: Apollo Gas Co. 1 Alexander Brown, 112,000 cu. ft. gas, Hundred-foot and Tiona sands, T.D. 3,540 ft.

Butler County

Clinton Township: S. W. Deitrich 1 Mehaffey (James Elkus), 5 bbl., Third sand 1,640-63 ft., T.D. 1,670 ft.

Clarion County

Limestone Township: T. Swartsfager et al 3 B. J. Reinsel, 79,000 cu. ft. gas, Speechley and Sheffield sands, T.D. 2,774 ft.

Fayette County

Springhill Township: Marker Stephenson 1 John Brojkovich, 140,000 cu. ft. gas, Fifty-foot sand 1,894 ft., gas 1,902 ft., T.D. 2,018 ft.

Greene County

Center Township: Morgan Henderson, agent, 5 J. L. Metz (Weir), dry, through Nineveh Thirty-foot sand, T.D. 3,645 ft.

Jefferson County

Beaver Township: T. W. Phillips 2 Huellett E. Smith, dry, through Bradford sand, T.D. 2,950 ft.

Washington County

South Franklin Township: Foley & Williams 1 J. J. Clark heirs (J. L. Walker), 260,000 cu. ft. gas, gas sand 1,238-95 ft., gas 1,254 ft., T.D. 1,350 ft.

J. L. Dunn et al 1 Clark heirs (Annie Clark), 281,000 cu. ft. gas, gas sand 1,240-95 ft., gas 1,260 ft., T.D. 1,328 ft.

WEST VIRGINIA

In Freemans Creek district, Lewis County, Hope Natural Gas Co. shut down the rotary test on the Alfred Woofter farm at 7,325 ft. and, after cleaning out, shot the Oriskany sand, in which there was a gas show, and is now cleaning out for test. The Oriskany sand was topped at 6,940 ft. In Morgan district, Monongalia County this company is drilling at 7,559 ft. in the test on the H. C. Greer et al lease and are 213 ft below the top of the Onondaga lime. The Oriskany sand is expected within a few feet.

Boone County

Washington district: Pond Fork Oil & Gas Co. 8 fee, 2,214,000 cu. ft. gas and 15 bbl. oil, Berea, T.D. 2,873 ft.

Hope 8580 A. C. Canterbury, 122,000 cu. ft. gas, Big lime 1,484-1,680 ft., Injun 1,680-1,717 ft., Berea 2,170-2,203 ft., show oil in shells at 2,103 ft., gas 2,170-74 ft., T.D. 2,238 ft.

Braxton County

Salt Lick district: Pittsburgh & West Virginia Gas Co. 7850 Jesse Norman, 51,000 cu. ft. gas before shot, Gordon sand 1,941-58 ft., T.D. 2,075 ft.

Cabell County

Kyle district: Vespa Drilling Co. 1 Armstrong Products Co., 84,000 cu. ft. gas, Big lime 1,030-1,175 ft., Injun 1,200-65 ft., Berea 1,805-20 ft., brown shale 2,360-2,625 ft., shot 2,267-2,667 ft., T.D. 2,667 ft.

Calhoun County

Center district: Hope 8751 R. M. Marshall, 700,000 cu. ft. gas, first salt 1,587-1,621 ft., gas 1,601-04 ft and 1,609-16 ft., T.D. 1,621½ ft.

Lee district: Everett Starcher 1 Edwin Starcher, 5,000 cu. ft. gas, Injun sand, T.D. 2,155 ft.

Sherman district: Hope 8565 Sarah Morris, 381,000 cu. ft. gas, Injun sand, T.D. 1,897 ft., Big lime 1,815-59 ft., gas 1,854-57 ft., shot 1,838-57 ft.

Hope 8569 Allen Hardman, 680,000 cu. ft. gas, Big Injun 2,054-56 ft., gas 2,054-56 ft., T.D. 2,063 ft.

Clay County

Henry district: Virginian Gasoline & Oil Co. V-1306 Brown, Swann & Goshorn, 6 bbl., Injun sand, T.D. 1,894 ft.

Doddridge County

Grant district: L. G. Pigott 1 Martha Scott, 134,000 cu. ft. gas, Pittsburgh coal 698 ft., drilled through Gordon sand, P.B. to Big Injun 2,026 ft., T.D. 2,744 ft.

Gilmer County

Troy district: A. E. Ellis 1 Myra Bell Hall, 630,000 cu. ft. gas, Big Injun 1,762-1,800 ft., gas 1,800 ft., T.D. 1,800 ft.

P. G. Loudin 1 Russell McQuain, dry, Big Injun 1,784-1,870 ft., T.D. 1,950 ft.

Marion County

Mannington district: South Penn 1 Jacob Cunningham, 15 bbl., Fourth sand, also 48,000 cu. ft. gas, T.D. 3,142 ft.

Pleasants County

Lafayette district: Schultz Oil Co. 2 Perry Riggs, 2 bbl. and 120,000 cu. ft. gas, Injun sand, T.D. 1,961 ft.

Putnam County

Scott district: Adkins Gas Co. 1 G. R. Fletcher, 78,860 cu. ft. gas, Big lime 1,556-1,720 ft., Big Injun 1,724-61 ft., Berea 2,216-40 ft., brown shale 3,410-3,800 ft. and 4,140-4,505 ft., gas 3,718-45 ft., shot 3,375-4,305 ft., 175,000 cu. ft. gas in Salt sand drowned out by water, T.D. 4,305 ft.

Ritchie County

Grant district: Schultz Oil Co. 10 T. C. Hammett heirs, 65 bbl., Squaw sand, T.D. 1,960 ft.

Murphy district: W. H. Bickel 1 B. F. Welch, 2,160,000 cu. ft. gas, Maxton sand, T.D. 1,694 ft.

Taylor County

Booths Creek district: Pittsburgh & West Virginia Gas Co. 6123 Bruce Barton, 650,000 cu. ft. gas, Big Injun 970-1,096 ft., gas 1,086-91 ft., T.D. 1,096 ft.

Upshur County

Buckhanan district: Pittsburgh & West Virginia Gas Co. 7839 G. W. Summers, 100,000 cu. ft. gas, Benson sand 4,563-76 ft., gas 4,566-74 ft., T.D. 4,595 ft.

Meade district: Cumberland & Allegheny Gas Co. 312 Ernest Phillips, dry, T.D. 4,364 ft.

Cumberland & Allegheny Gas Co. 313 F. G. Burr, dry, Gordon sand 1,973-87 ft., T.D. 2,144 ft.

Wayne County

Union district: Owens, Libby-Owens 1 Floyd Booth, 112,000 cu. ft. gas, Big lime 1,380-1,573 ft., Injun 1,573-1,763 ft., Berea 2,173-2,201 ft., brown shale 2,619-3,341 ft., Corniferous lime 3,341 ft., shot 2,610-3,339 ft., T.D. 3,346 ft.

ORISKANY GAS FIELDS

Jackson County

Ravenswood district: United Fuel 5033 Roane County Bank lease, 9,005,000 cu. ft. gas before shot, Corniferous lime 4,925 ft., Oriskany 5,038 ft., gas 5,039-55 ft., T.D. 5,058 ft.

SUMMARY OF COMPLETIONS

Southwest Pennsylvania

	No.	Bbl.	Footage
Oil wells	1	5	1,670
Gas wells	5	*0.9	11,010
Dry holes	2	.....	6,595
Total	8	.....	19,275

West Virginia

	No.	Bbl.	Footage
Oil wells	4	88	9,957
Gas wells: Oriskany	4	*21.6	20,408
Other	14	*8.1	35,244
Dry holes	4	.....	10,613
Total	26	.....	76,322

Permian Basin, Panhandle Fields

(Continued from Page 218)

pletions during the week totaled 12 oil producers and 4 gas wells.

The South Plains wildcat has been staked by Bruce Sullivan of Fort Worth, Tex. The test will be known as 1 L. V. Anderson, located in Section 23, Block M. R. M. Thompson Survey, Cottle County.

The shutting down of the Humble 1-D Matador will be the fourth disappointment for the Motley County area. The test topped solid granite at 6,266 ft., and shut down after drilling 3 ft. into the hard material, giving a total depth of 6,269 ft. It is located 3,300 ft. from the north line and 660 ft. from the east line of Section 127, in the John H. Gibson Survey.

TEXAS PANHANDLE COMPLETIONS

(24-hr. rating)

Carson County: Perkins-Prothro Co. 13 Burnett, Sec. 115, Blk. 5, I.&G.N. Sur., 210 bbl. oil and 40 bbl. water, pay 3,027-85 ft.

Gray County: Skelly Oil Co. 4 Lovett, Blk. B-2, H.& G.N. Sur., 279 bbl., pumping, 243-qt. shot 2,920-57 ft., T.D. 2,962 ft.

Skelly Oil Co. 3 Taylor, Sec. 24, Blk. B-2, H.&G.N. Sur., 189 bbl., pumping, 355-qt. shot, 2,878-2,943 ft.

Taylor Oil Co. 8-B Taylor, Sec. 24, Blk. B-2, H.& G.N. Sur., 130 bbl., pumping, 870-qt. shot 2,775-2,889 ft.

Hutchinson County: Harvester Oil Co. 8 Haile, Sec. 4, Blk. M-21, T.C. Sur., 215 bbl., pumping, 390-qt. shot 3,009-63 ft.

Huber Corp. 18 Weatherly, Sec. 25, Blk. Y, A.&B. Sur., 588 bbl., pumping, 2,980-3,060 ft.

Phillips 85 Cockrell ranch, Sec. 11, Blk. B-3, D.& S.R. Sur., 193 bbl., pumping, 380-qt. shot 2,884-3,065 ft.

Phillips 1 Walker, Sec. 19, Blk. M-16, A.B.&M. Sur., 261 bbl., pumping, 220-qt. shot 3,204-48 ft.

Sinclair 14 Johnson ranch, Sec. 32, Blk. Y, A.&B. Sur., 41 bbl., pumping, pay 3,032-90 ft., P.B. from 3,115 ft.

Stanolind 3 Mathis, Sec. 12, Blk. L, E.L. Sur., 148 bbl., pumping, 400-qt. shot 2,950-3,012 ft.

Earl Wherry 2 Harvey, Sec. 74, Blk. Z, E.L. Sur., 90 bbl., pumping, 245-qt. shot 2,932-77 ft.

Moore. County: Texoma Natural Gas Co. 2-M J. W. Moore, Sec. 30, Blk. 44, H.&T.C. Sur., 6,600,000 cu. ft. gas, pay 3,172-3,420 ft., P.B. from 3,617 ft.

Texoma Natural Gas Co. 2 W. H. Taylor, Sec. 17, Blk. M-1, 23,200,000 cu. ft. gas, pay 2,825-3,226 ft., P.B. from 3,246 ft.

Texoma Natural Gas 1-T M. B. Williams, Sec. 234, Blk. 44, H.&T.C. Sur., 13,500,000 cu. ft. gas, pay 3,015-3,155 ft., P.B. from 3,430 ft.

Potter County: U. S. Bureau of Mines 3-A Bivins, Sec. 26, Blk. 6, B.S.&F. Sur., 21,300,000 cu. ft. gas, pay 3,031-3,247 ft.

Wheeler County: Clark 4 Sloss, Sec. 90, Blk. 3, H.& G.N. Sur., 80 bbl., pumping, 150-qt. shot 2,100-36 ft., P.B. from 2,149 ft.

Wildcat Staked East of Maljamar And West of Vacuum Pools

HOBBS, N. M., Nov. 3.—Lea County held Southeast New Mexico oil interest as Phillips Petroleum Co. staked location for a wildcat test 3 miles east of the Maljamar pool and 7 miles west of the Vacuum pool. It is 1 Philmex, 660 ft. from the north and west lines of 28-17s-33e, in an area heavily blocked by Phillips as the result of extensive core testing. No. 1 Philmex lies 1½ miles west and ¼ mile south of Richmond Drilling Co., Midland, 1 Shell Oil Co., Inc.-State, a failure abandoned last week.

The Richmond dry hole, 660 ft. from the south and 1,980 ft. from the east line of 22-17s-33e, was abandoned at 4,600 ft., plugged back from total depth of 4,805 ft. in lime, after swabbing an estimated 8 bbl. of oil and an equal amount of water on final test. It was acidized and also shot with 370 qt.

NEW MEXICO COMPLETIONS

Wildcats

Lea County: Richmond Drilling 1 Shell-State, S½ SW SE 22-17s-33e, dry, T.D. 4,805 ft. in lime, P.B. 4,600 ft., shot and acid, swabbed 8 bbl. oil and 8 bbl. water.

Fields

Red Lakes, Eddy County: Comanche Drilling 19 Berry, 24-17s-27e, pumped 40 bbl., acid, pay 470 ft., T.D. 477 ft.

Otis A. Roberts 1 Patterson-State, 25-17s-27e, pumped 17½ bbl., pay 493-99 ft., acid, T.D. 499 ft.

R. J. Johnson 2 Harbold, 26-17s-27e, pumped 12 bbl., pay 458-70 ft., acid, T.D. 470 ft.

William P. Dooley 1 State, 36-17s-27e, pumped 25 bbl., pay 504 ft., acid, T.D. 510 ft.

James E. Hughes 6 Brooks, 19-17s-28e, pumped 7 bbl. oil and ½ bbl. water, pay 542 ft., acid, T.D. 556 ft. in sandy lime.

Loco Hills, Eddy County: Dixon & Yates 4-A Saunders, 12-18s-29e, flowed 120 bbl. in 3½ hr. through 2-in. tubing, pay sand 2,776 ft., shot 2,764-2,804 ft., T.D. 2,805 ft.

Producing Methods for Zones At Olla and Little Creek Vary

SHREVEPORT, La., Nov. 3.—The Central Louisiana Wilcox sand producing fields of Olla, South Olla and Little Creek offer somewhat of a variety of producing practices. This is because of varying conditions in the fields and in different parts of individual fields. These fields are now just at the height of their development, having been opened only slightly more than a year ago. Extensions to the producing area are being constantly made. Production comes from five separate and relatively thin zones of sand saturation within some 2,500 ft. of Wilcox section in the area.

Even though types of producing wells vary in the fields, the variation is more or less uniform since practically all of the productive leases are held by a few operators. In the Olla and South Olla fields the two main producers are H. L. Hunt, Dallas, and Arkansas Fuel Oil Co., Shreveport. Development in the areas is held to one well per 40-acre tract. However, this may be reduced by half or to 20-acre spacing if engineering reports indicate that one well does not drain a 40-acre tract.

Types of Producing Methods

There are three producing methods used widely throughout the field. Definite conditions determine which installation shall fit which well. Naturally, good strong wells with ample bottom-hole pressure and daily gas volume are considered for flowing wells. No artificial means is needed to bring oil from this type of well to the surface. If the daily gas volume is low, bottom-hole pressure is below average for the field, or salt-water output is greater than normal and the daily oil potential is below average, then either one of the other two methods must be decided upon.

As a general rule wells with the least pressure are put on gas lift, while wells with insufficient pressure to flow but still having appreciable bottom-hole pressure and gas volume are put on the pump. Another factor determines pumping and gas-lift wells in the fields also. H. L. Hunt owns several gas wells in the fields and has sufficient volume to operate gas-lift wells. Arkansas Fuel Oil Co. attempts to complete only oil wells in the area and when a gas well is indicated, squeeze and reperforating job is made to shut off the gas and find the oil zone. For this reason the majority of the gas-lift wells are owned by Hunt and most of the pumping wells are owned by Arkansas Fuel Oil Co. The latter firm does, however, have four or five gas-lift wells and Hunt also has several pumpers.

The gas-lift installation is more or less conventional with the rate of tubing fill-up determining the setting of the intermitter. The wells are usually set to kick off about each 10-minute period to empty the tubing of oil. Some of the gas-lift installations are on wells with appreciable pressure and gas volume, thus the lift acts mainly as an agitator with the well actually flowing some oil during the intermittent period between lifts.

The design is conventional with the time clock hooked up to the intermitter regulator and adjustable for any desired period. When the lift is set off gas pressure forces a piston upward in a cylinder suspended over the well head. This pulls up the wire line and opens the jets at the bottom of the well, allowing the gas which is forced down to bottom through the casing to enter the bottom of the tubing. This gas then forces the oil load out of the tubing and into the tanks. It shuts off after about 1½ minutes.

Pumping Installation

When gas for the gas-lift installation is not readily available, and when the well pressure and gas volume is not too low, a light pumping unit is installed. As is the case with the gas lift, when the pressure is fairly good the pump serves only as an agitator. Many wells are pumped only at the start of their production period and will flow naturally once made to kick off.

The small pumping unit is driven by a 15-h.p., one-cylinder engine. These engines usually start on gasoline and are switched over to operate on gas, the gas being made available from the draw-off at the top of separators on nearby leases.

All wells in the fields produce some salt water and gas in solution and a more or less conventional salt-water disposal and treating setup is found throughout. The oil is treated, run through the separator, heaters, gun barrels, and thus into storage. Gas from the separator is used to evaporate the salt water in large open pits.

Rocky Mountain Runs

Production estimates for week ended November 1, 1941:

NEW MEXICO

Arrowhead	4,210
Cooper	2,990
Corbin	40
Eaves	850
Eunice	18,900
Halfway	380
Hardy	2,100
Hobbs	10,400
Jal	390
Langlie	4,140
Lynch	440
Lynch	1,000
Maljamar	4,170
Monument	20,200
North Lynch	30
Penrose	3,380
Rhoades	50
Salt Lake	170
Skaggs	60
Skelly	1,690
South Eunice	2,800
South Lovington	1,530
Vacuum	13,860
West Eunice	520
Artesia-Maljamar	20,980
Aztec-Bloomfield	10
Getty	90
Hogback	200
Rattlesnake	280
Table Mesa	100
Total New Mexico	116,420

WYOMING

Salt Creek	12,740
Big Muddy	1,160
Badger Basin	160
Black Mountain	100
Byron	4,380
Cody Dome	40
Cole Creek	740
Dallas Derby	490
Dutton Creek	40
East Mahoney-Ferris	230
Elk Basin	760
Frannie	3,620
Garland	1,550
Grass Creek	1,820
Hamilton Dome	890
Hidden Dome	100
Hudson	280
Iron Creek	20
LaBarge	2,140
Lance Creek	22,620
Lost Soldier	5,830
Mahoney	1,040
Maverick Springs	2,260
Medicine Bow	690
Mule Creek	400
Oregon Basin	8,590
Osage	600
Poison Spider	190
Quealy Dome	440
Rex Lake	90
Rock River	2,600
So. Casper Creek	420
Teapot	10
Warm Springs	70
Wertz	4,820
Total Wyoming	81,930
Total Rocky Mountain region	224,100

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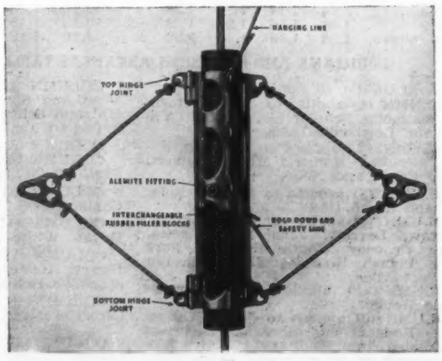

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CRUDE-OIL PRICES . . .

OKLAHOMA AND KANSAS GRAVITY TABLES

	1	2	3	4	5	6	7	8
Below 21					$.85	$.75	....	$.70
21-21.9					.87	.78	....	.73
22-22.9					.89	.81	....	.76
23-23.9					.91	.84	....	.79
24-24.9					.93	.87	....	.82
Below 25	$.93	....	....	$.86	....	....	....	....
25-25.9	.95	.95	....	.88	.95	.90	....	.85
26-26.9	.97	.97	....	.90	.97	.93	....	.88
27-27.9	.99	.99	....	.92	.99	.96	....	.91
28-28.9	1.01	1.01	1.01	.94	1.01	.99	....	.94
29-29.9	1.03	1.03	1.03	.96	1.03	1.02	....	.97
30-30.9	1.05	1.05	1.05	.98	1.05	1.05	$1.05	1.00
31-31.9	1.07	1.07	1.07	1.00	1.07	1.07	1.07	1.02
32-32.9	1.09	1.09	1.09	1.02	1.09	1.09	1.09	1.04
33-33.9	1.11	1.11	1.11	1.04	1.11	1.11	1.11	1.06
34-34.9	1.13	1.13	1.13	1.06	1.13	1.13	1.13	1.08
35-35.9	1.15	1.15	1.15	1.08	1.15	1.15	1.15	1.10
36-36.9	1.17	1.17	1.17	1.10	1.17	1.17	1.17	1.12
37-37.9	1.19	1.19	1.19	1.12	1.19	1.19	1.19	1.14
38-38.9	1.21	1.21	1.21	1.14	1.21	1.21	1.21	1.16
39-39.9	1.23	1.23	1.23	1.16	1.23	1.23	1.23	1.18
40 and above	1.25	1.25	1.25	1.18	1.25	1.25	1.25	1.20

OKLAHOMA AND KANSAS TABLE EXPLANATION

COLUMN (1) MID-CONTINENT GRADES:
Pure Oil Co., 5-20-41.
Gulf Oil Corp., 5-20-41.
Skelly Oil Co. (Kansas only), 5-19-41.
H. F. Wilcox Oil & Gas Co., 5-20-41.

COLUMN (2) MID-CONTINENT GRADES:
White Eagle Oil Purchasing Co., Inc., 5-19-41, Kansas only.
Sinclair Prairie Oil Marketing Co., 5-20-41.

COLUMN (3) MID-CONTINENT GRADES:
Continental Oil Co., 5-19-41.
Phillips Petroleum Co., 5-19-41.
Tide Water Associated Oil Co., 5-20-41.

COLUMN (4) JACKSON, TILLMAN COUNTIES:
Gulf Oil Corp., 5-20-41.

COLUMN (5) MID-CONTINENT GRADES:
Standard Oil Co., (Indiana), 5-20-41.
National Refining Co., 5-20-41.

COLUMN (6) MID-CONTINENT GRADES:
Magnolia Petroleum Co., 5-21-41.
Shell Oil Co., Inc., 5-19-41.

COLUMN (7) OKLAHOMA:
Champlin Refining Co., 5-20-41.

COLUMN (8) CARTER COUNTY, OKLAHOMA including Healdton, Oscar, Spring and Seay.
Shell Oil Co., Inc., 5-19-41.
Ben Franklin Refining Co., 5-20-41.

OKLAHOMA FLAT PRICE

Cumberland $1.14
Pure Oil Co., 9-4-41.

MIDDLE WEST FLAT PRICES

Illinois and Indiana

Ohio Oil Co.:
Illinois basin, 5-21-41 ..... $1.37
Carter Oil Co.:
Illinois (Louden), 5-21-41 ..... $1.37
Sohio Corp.:
Illinois basin, 5-21-41 ..... $1.37
Texas Co.:
Illinois basin, 5-21-41 ..... $1.37
Gulf Refining Co.:
Illinois basin, 5-21-41 ..... $1.37

Michigan

Simrall Corp., 5-27-41:
Greendale, Porter, Vernon, Crystal, and Wise $1.44
Buckeye, Bentley, Edenville, Beaverton, and Monitor (sweet) 1.42
Freeman, Redding, Lincoln, and Winterfield 1.39
Hamilton-Grout 1.29
West Branch-Arenac 1.24
Sohio Corp., 5-1-41:
Bloomingdale-Columbia $1.38
Mid-West Refineries, Inc., 5-1-41:
Kent County $1.38
Pure Oil Co., 5-27-41:
Sherman $1.39
Midland (Midland County) $1.44

EASTERN STATES

Pennsylvania and Ohio

South Penn Oil Co.:
National lines, 8-23-41 ..... $2.75
Southwest Penn, 8-23-41 ..... 2.40
Eureka lines, 8-23-41 ..... 2.34
Corning grade, 5-27-41 ..... 1.31
Tide Water Associated Oil Co.:
Bradford, 8-23-41 ..... 2.75
Allegany, N. Y., 8-23-41 ..... 2.75
Pennzoil Co.:
Group A, 8-23-41 ..... 2.68
Group B, 8-23-41 ..... 2.67
Group C, 8-23-41 ..... 2.66
Group D, 8-23-41 ..... 2.65
Group E, 8-23-41 ..... 2.63
Quaker State Oil Refining Corp.:
In Buckeye lines, 8-23-41 ..... 2.30
In Eureka lines, 8-23-41 ..... 2.34

West Virginia

Pure Oil Co.:
Cabin and Kelly Creek, 8-23-41 .. $2.34
Eastern Illinois, 5-21-41 ..... 1.22
Western Indiana, 5-21-41 ..... 1.22
Magnolia Petroleum Co.:
Illinois basin, 5-21-41 ..... $1.37

LOUISIANA AND SOUTHERN ARKANSAS GRAVITY TABLE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Below 18	....	....	....	....	....	....	....	....	....	....	....	....	$.94	....	....	....	....	....
18-18.9	....	....	....	....	....	....	....	....	....	....	....	....	.96	....	....	....	....	....
19-19.9	....	....	....	....	....	....	....	....	....	....	....	....	.98	....	....	....	....	....
Below 20	....	....	....	....	....	....	....	$1.06	....	$.94	$.99	$.89	....	....	$1.06	....	....	....
20-20.9	....	....	....	....	....	....	....	1.08	....	.96	1.01	.91	1.00	....	1.08	....	....	....
Below 21	$.68	....	....	$.90	....	....	....	....	....	....	....	....	....	$.90	....	....	....	....
21-21.9	.70	....	....	.92	....	....	....	1.10	....	.98	1.03	.93	1.02	.92	1.10	....	....	....
22-22.9	.72	....	....	.94	....	....	....	1.12	....	1.00	1.05	.95	1.05	.94	1.12	....	....	....
23-23.9	.74	....	....	.96	....	....	....	1.14	....	1.02	1.07	.97	1.08	.96	1.14	....	....	....
24-24.9	.76	....	....	.98	....	....	....	1.16	....	1.04	1.09	.99	1.11	.98	1.16	....	....	....
Below 25	....	$.86	$.98	....	....	$.88	....	....	....	....	....	....	....	....	....	....	....	....
25-25.9	.78	.88	1.00	1.00	....	.90	....	1.18	....	1.06	1.11	1.01	1.14	1.00	1.18	....	....	....
26-26.9	.80	.90	1.02	1.02	....	.92	....	1.20	....	1.08	1.13	1.03	1.17	1.02	1.20	....	....	....
27-27.9	.82	.92	1.04	1.04	....	.94	....	1.22	....	1.10	1.15	1.05	1.19	1.04	1.22	....	....	....
28-28.9	.84	.94	1.06	1.06	....	.96	....	1.24	....	1.12	1.17	1.07	1.21	1.06	....	$1.14	$1.06	....
29-29.9	.86	.96	1.08	1.08	....	.98	....	1.26	....	1.14	1.19	1.09	1.23	1.08	....	1.16	1.08	....
30-30.9	.88	.98	1.10	1.10	$1.26	1.00	....	1.28	....	1.16	1.21	1.11	1.25	1.10	....	1.18	1.10	$1.05
31-31.9	.90	1.00	1.12	1.12	1.28	1.02	....	1.30	$1.07	1.18	1.23	1.13	1.27	1.12	....	1.20	1.12	1.07
32-32.9	.92	1.02	1.14	1.14	1.30	1.04	....	1.32	1.09	1.20	1.25	1.15	1.29	1.14	....	1.22	1.14	1.09
33-33.9	.94	1.04	1.16	1.16	1.32	1.06	....	1.34	1.11	1.22	1.27	1.17	1.31	1.16	....	1.24	1.16	1.11
34-34.9	.96	1.06	1.18	1.18	1.34	1.08	....	1.36	1.13	1.24	1.29	1.19	1.33	1.18	....	1.26	1.18	1.13
35-35.9	.98	1.08	1.20	1.20	1.36	1.10	....	....	1.15	....	....	....	....	1.20	....	1.28	1.20	1.15
Below 36	....	....	....	....	....	....	$1.07	....	....	....	....	....	....	....	....	....	....	....
36-36.9	1.00	1.10	1.22	1.22	....	1.12	1.09	....	1.17	....	....	....	....	1.22	....	1.30	1.22	1.17
37-37.9	1.02	1.12	1.24	1.24	....	1.14	1.11	....	1.19	....	....	....	....	....	....	....	....	1.19
38-38.9	1.04	1.14	1.26	1.26	....	1.16	1.13	....	1.21	....	....	....	....	....	....	....	....	1.21
39-39.9	1.06	1.16	1.28	1.28	....	1.18	1.15	....	1.23	....	....	....	....	....	....	....	....	1.23
40 & above	1.08	1.18	1.30	1.30	....	1.20	1.17	....	1.25	....	....	....	....	....	....	....	....	1.25

LOUISIANA AND SOUTHERN ARKANSAS TABLE EXPLANATION

Standard Oil Co. of Louisiana, 5-22-41.
COLUMN (1) applies to Atlanta, Buckner, Magnolia, Schuler (Jones sand), Village and Lewisville fields.
COLUMN (2) applies to De Soto, Sabine, Fouke, Homer, Miller County, Sugar Creek and Nebo.
COLUMN (3) applies to Bunkie, Eola, Olla and South Olla.
COLUMN (4) applies to Bayou Mallet, Choctaw, Darrow, Jeanerette, Lirette, North Crowley, South Crowley, Port Barre, Potash, Roanoke, St. Martinville and Port Allen.
COLUMN (5) applies to University (Baton Rouge).
COLUMN (6) applies to Cotton Valley crude, Rodessa and Shreveport (Cross Lake); also Anse La Butte, effective 8-1-41, starting at 80 cents for below 21°, also, to Caddo effective 10-15-41.
Continental Oil Co., 5-21-41.
COLUMN (7) applies to Abbeville, Louisiana.
Continental Oil Co., 5-21-41.
Stanolind Oil & Gas Co., 5-21-41.
COLUMN (8) applies to East and West Hackberry.
COLUMN (6) applies to Caddo Parish, effective 10-15-41.
COLUMN (9) applies to Evangeline, Acadia Parish.
Lion Oil Refining Co., 5-22-41.
COLUMN (1) applies to Reynolds lime, Jones sand, Schuler, Ark.
COLUMN (2) applies to El Dorado, West and South Rainbow fields, Snow Hill and Schuler-Morgan sand.
Placid Oil Co., 5-22-41.
COLUMN (3) applies to Olla.
COLUMN (2) applies to Nebo field.
Shell Oil Co., Inc., 5-20-41.
COLUMN (10) applies to Roanoke, Chalkley.
COLUMN (11) applies to Iowa, Black Bayou, White Castle.
COLUMN (12) applies to Gibson, South Houma, Hester, West Lake Verret.
Magnolia Petroleum Co., 5-21-41.
COLUMN (13) applies to Lockport, Cameron Meadows, and West Gueydan, La.
COLUMN (6) applies to Haynesville, Cotton Valley, Rodessa, La., and Miller County, Arkansas.
Phillips Petroleum Co., 3-29-41.
COLUMN (1), Schuler (Jones sand), except schedule starts at 76 cents for below 28° gravity.
Gulf Refining Co., 5-21-41.
COLUMN (9), Jennings.
COLUMN (8), Edgerly, Starks, Vinton, East Hackberry, Cameron Meadows, Leesville.
COLUMN (16) applies to Grand Bay, Quarantine Bay, Timbalier Bay and West Bay, except schedule starts at $1.12 for below 28° gravity.
COLUMN (6) applies to Caddo, Homer, Bull Bayou, Crichton, De Soto, Haynesville and El Dorado.
Pure Oil Co. 4-22-41.
COLUMN (14) applies to Gueydan crude.
COLUMN (6), Caddo, Homer, Haynesville, Bull Bayou, Crichton, De Soto, and El Dorado.
Texas Co., 5-21-41.
COLUMN (6) applies to North Louisiana.
COLUMNS (15) and (16), Bay St. Elaine, Caillou Island, Iberia, Lake Barre, Lake Pelto, Leesville, Port Barre. (Schedules A and B).
COLUMN (17), Bateman Lake, Dog Lake, Fausse Point, Horseshoe Bayou, Jefferson Island, Plumb Bob, Vermilion Bay, West Cote Blanche and Delta Duck Club.
COLUMN (18), Delta Farm, Lake Salvador, Golden Meadow.

LOUISIANA AND ARKANSAS FLAT PRICES

Continental Oil Co., 5-21-41:
Tepetate and Lake Arthur $1.18
Ville Platte 1.20
Gulf Refining Co., 5-21-41:
Smackover (Ark.) $0.83
Lion Oil Refining Co., 5-22-41:
Smackover (heavy) $0.83
Dorcheat 1.15
Phillips Petroleum Co., 5-22-41:
Smackover (heavy) $0.83
Placid Oil Co., 5-22-41:
Tullos-Urania (5-21-41) $1.18
Cotton Valley dist. (above 60°) .. 1.30
Cotton Valley (Holloway sand) .. 1.25
Cotton Valley (Bodcaw-D sands) 1.20
Pure Oil Co.:
Bosco (5-21-41) $1.14
Sweet Lake (5-22-41) 1.06
Creole (5-22-41) 1.16
Republic Oil Co., 6-2-41:
Nevada County, Arkansas $0.80
Shell Oil Co., Inc., 5-20-41:
Happytown $1.15
Standard Oil Co. of Louisiana, 5-22-41:
Big Creek, Dorcheat, McKamie (sour) $1.15
Smackover (heavy) ..... .83
Cotton Valley distillate (9-1-41) 1.40
Cotton Valley (Holloway sand) .. 1.25
Lisbon distillate 1.20
Republic Oil Refining Co., 5-21-41:
Bayou Pigeon $1.20
Texas Co., 5-21-41:
Erath $1.21
Garden Island 1.36
Lafitte, Paradis 1.19
Lake Mongoulois 1.36

ROCKY MOUNTAIN GRAVITY TABLE

Below 29 ..... $0.96
29-29.9 ..... .98
30-30.9 ..... 1.00
31-31.9 ..... 1.02
32-32.9 ..... 1.04
33-33.9 ..... 1.06
34-34.9 ..... 1.08
35-35.9 ..... 1.10
36-36.9 ..... 1.12
37-37.9 ..... 1.14
38-38.9 ..... 1.16
39-39.9 ..... 1.18
40 and above 1.20

Stanolind Oil & Gas Co., 5-20-41, includes Dutton Creek, Midway and Salt Creek except Tensleep crude, Wyoming.
Sinclair Wyoming Oil Co., 5-20-41, includes Salt Creek and Lost Soldier, except Tensleep crude, Wyoming.
Continental Oil Co., 5-21-41, includes Fort Collins and Wellington, Colorado.

Wyoming

Ohio Oil Co.:
Rock River (5-20-41) $1.15
Lance Creek (7-1-41) 1.12
Elk Basin and Grass Creek (light) 1.00
Stanolind Oil & Gas Co., 5-20-41:
Frannie (light) ..... .70
Frannie (heavy) ..... .47
Grass Creek (light) 1.00
Grass Creek (heavy) ..... .50
Hamilton Dome ..... .45
Elk Basin 1.00
Salt Creek (Tensleep) ..... .6785
Continental Oil Co.:
Big Muddy (5-30-41) $1.08
Lance Creek (9-1-41) 1.12

TEXAS GULF COAST GRAVITY TABLES

	(1)	(2)	(3)	(4)	(5)
Below 20	$1.06	$1.06	....	$.98	$.93
20-20.9	1.08	1.08	....	1.00	.95
Below 21	....	....	$1.08	....	....
21-21.9	1.10	1.10	1.10	1.02	.97
22-22.9	1.12	1.12	1.12	1.04	.99
23-23.9	1.14	1.14	1.14	1.06	1.01
24-24.9	1.16	1.16	1.16	1.08	1.03
25-25.9	1.18	1.18	1.18	1.10	1.05
26-26.9	1.20	1.20	1.20	1.12	1.07
27-27.9	1.22	1.22	1.22	1.14	1.09
28-28.9	1.24	1.24	1.24	1.16	1.11
29-29.9	1.26	1.26	1.26	1.18	1.13
30-30.9	1.28	1.28	1.28	1.20	1.15
31-31.9	1.30	1.30	1.30	1.22	1.17
32-32.9	1.32	1.32	1.32	1.24	1.19
33-33.9	1.34	1.34	1.34	1.26	1.21
34-34.9	1.36	1.36	1.36	1.28	1.23
35-35.9	1.38	....	1.38	1.30	1.25
36-36.9	1.40	....	1.40	1.32	1.27
37-37.9	1.42	....	1.42	1.34	1.29
38-38.9	1.44	....	1.44	1.36	1.31
39-39.9	1.46	....	1.46	1.38	1.33
40 and above	1.48	....	1.48	1.40	1.35

TEXAS GULF COAST GRAVITY TABLE EXPLANATION

COLUMN (1):
Humble Oil & Refining Co., 5-21-41, includes Amelia, Clear Lake, Goose Creek, Hastings, Magnet, Mykawa (new), Raccoon Bend, South Thompsons, Sugarland, Thompsons, and Webster fields.
Stanolind Oil & Gas Co., 5-21-41, includes West Beaumont, High Island and Spindletop.
Sinclair Prairie Oil Marketing Co., 5-21-41.
Stanolind Oil Purchasing Co., 4-1-41, includes Clinton where schedule starts at 98 cents for below 21°, regular thereafter.
Pure Oil Co., 4-21-41, includes Louise and Ganado.
Gulf Refining Co., 5-21-41, includes Spindletop, Sour Lake, Lovells Lake, West Beaumont, Goose Creek, South Liberty, Big Creek, Blue Ridge, Fannett, Moore, Barbers Hill, Hankamer, Thompson, Lochridge, Dyersdale, and Hull (old).
Sun Oil Co., 5-21-41, includes Barbers Hill, Batson (old), Bayou Blue, Chacahoula, Cotton Lake, Esperson (below 35° gravity), Fausse Pointe, Goose Creek, Greens Lake, Hackberry (east and west), Hull (below 25°), Humble (below 35°), Nome, North Dayton (below 25°), Orange, Saratoga, Sour Lake, South Liberty and Vinton.
COLUMN (2):
Texas Co., 5-21-41, includes Arriola, Ganado, Hamman, Hillje, Humble, Kubela, Magnet, Manvel, Markham, Mauritz, Old Ocean, Pickett Ridge, Port Neches, Sour Lake, West Columbia, and Withers.
COLUMN (3):
Pan American Production Co., 5-21-41,

includes Hastings and South Houston.
Stanolind Oil & Gas Co., 4-1-41, includes High Island, Spindletop, Hastings, and South Houston.
COLUMN (4):
Humble Oil & Refining Co., 5-21-41, includes Anahuac, Angleton, Cedar Point, Fishers' Reef, Hull (new and old), Pierce Junction, Red Fish Reef, and Turtle Bay.
Gulf Refining Co., 5-21-41, includes Anahuac, Hull (new), Thompson (deep), Pierce Junction, and Orange.
Sun Oil Co., 5-21-41, includes Anahuac, Caplen and Turtle Bay.
Humble Oil & Refining Co., 3-29-41, includes Dickinson, Gillock, Hardin, League City, and Rowan.
Stanolind Oil & Gas Co., 5-21-41, includes Fairbanks, North Houston, and Rosyln.
COLUMN (5):
Pan American Production Co., 5-21-41, includes Gillock, except scale starts at 95 cents below 21°.

SOUTH TEXAS AND SOUTHWEST TEXAS GRAVITY TABLES

	1	2	3	4	5	6	7
Below 20	$1.03	$1.08	$1.08	$.89	$1.03	$1.03	$1.08
20-20.9	1.05	1.10	1.10	.90	1.05	1.05	1.10
21-21.9	1.07	1.12	1.12	.91	1.07	1.07	1.12
22-22.9	1.09	1.14	1.14	.92	1.09	1.09	1.14
23-23.9	1.11	1.16	1.16	.93	1.11	1.11	1.16
24-24.9	1.13	1.18	1.18	.94	1.13	1.13	1.18
25-25.9	1.15	1.20	1.20	.95	1.15	1.15	1.20
26-26.9	1.17	1.22	1.22	.96	1.17	1.17	1.22
27-27.9	1.19	1.24	1.24	.97	....	1.19	1.24
28-28.9	1.21	1.26	1.26	.98	....	1.21	1.26
29-29.9	1.23	1.28	....	.99	....	....	1.28
30-30.9	1.25	1.30	....	1.00	....	....	1.30
31-31.9	1.27	1.32	....	1.01	....	....	1.32
32-32.9	1.29	1.34	....	1.02	....	....	1.34
33-33.9	1.31	1.36	....	1.03	....	....	1.36
34-34.9	1.33	1.38	....	1.04	....	....	1.38
35-35.9	1.35	1.40	....	1.05	....	....	1.40
36-36.9	1.37	1.42	....	1.06	....	....	....
37-37.9	1.39	1.44	....	1.07	....	....	....
38-38.9	1.41	1.46	....	1.08	....	....	....
39-39.9	1.43	1.48	....	1.09	....	....	....
40 and above	1.45	1.50	....	1.10	....	....	....

SOUTH AND SOUTHWEST TEXAS TABLE EXPLANATION

COLUMN (1) MIRANDO:
Humble Oil & Refining Co., 5-21-41, includes Blanchard, Bridwell, Colorado, Comitas, Eagle Hill, Escobas, Fitzsimmons, Glen, Government Wells (North and South), Heyser, Hoffman, Kelsey, Kohler, Loma Novia, Lundell, Manila, Mirando Valley, Placedo, Randado, Sarnosa, and Tesoro.
Magnolia Petroleum Co., 5-21-41.
Continental Oil Co., 7-1-41. Includes Hoffman, Government Wells (North and South), Lopez, Moco, Colmena, Seven Sisters, South Seven Sisters, Loma Novia, Conoco Driscoll, O'Hern, Piedre Lumbre, and Taranchauas.
Amsco Pipe Line Co., 5-21-41, includes Adami and Munson.
Republic Oil Refining Co., 5-21-41, includes Heyser field crude.
COLUMN (2) REFUGIO:
Continental Oil Co., 7-1-41, includes Minnie Bock, Clara Driscoll, South Clara Driscoll, Driscoll Ranch, Orange Grove, and Wade City.
Humble Oil & Refining Co., 5-21-41. Includes East White Point, Greta, Melon Creek, O'Connor-McFaddin, Plymouth, Saxet, Taft, and Tom O'Connor.
Amsco Pipe Line Co., 5-21-41, includes Plymouth, Taft, and East White Point.
COLUMN (3) REFUGIO:
Texas Co., 5-21-41, includes Greta, Saxet, and Taft.
COLUMN (4) LA ROSA:
Amsco Pipe Line Co., 3-29-41.
COLUMN (5) DUVAL-MIRANDO:
Sun Oil Co., 5-21-41.
COLUMN (6) DUVAL-MIRANDO:
Texas Co., 5-21-41.
COLUMN (7) NUECES COUNTY:
Amsco Pipe Line Co., 5-21-41.
Republic Oil Refining Co., 5-21-41.

WEST TEXAS, PANHANDLE AND NEW MEXICO GRAVITY TABLES

	1	2	3	4	5	6	7	8	9	10	11
Below 20	$0.70	....	....	....	....	....	....	....	$0.70	$.73	....
20-20.9	.72	....	....	....	....	....	....	....	.72	.75	....
21-21.9	.74	....	....	....	....	....	....	....	.74	.77	....
22-22.9	.76	....	....	....	....	....	....	....	.76	.79	....
23-23.9	.78	....	$0.78	....	....	....	....	....	.78	.81	....
24-24.9	.80	....	.80	....	....	....	....	....	.80	.83	....
Below 25	....	$0.80	....	....	....	....	....	$0.80	....	....	$9.83
25-25.9	.82	.82	.82	....	$0.82	....	.82	....	.82	.85	.85
26-26.9	.84	.84	.84	....	.84	....	.84	....	.84	.87	.87
27-27.7	.86	.86	.86	....	.86	....	.86	....	.86	.89	.89
28-28.9	.88	.88	.88	$0.91	.88	....	.88	$0.88	.88	.91	.91
29-29.9	.90	.90	.90	.93	.90	....	.90	.90	.90	.93	.93
30-30.9	.92	.92	.92	.95	.92	....	.92	.92	.92	.95	.95
31-31.9	.94	.94	.94	.97	.94	....	.94	.94	.94	.97	.97
32-32.9	.96	.96	.96	.99	.96	....	.96	.96	.96	.99	.99
33-33.9	.98	.98	.98	1.01	.98	....	.98	.98	.98	1.01	1.01
34-34.9	1.00	1.00	1.00	1.03	1.00	$1.03	1.00	1.00	1.00	1.03	1.03
35-35.9	1.02	1.02	1.02	1.05	1.02	1.05	1.02	1.02	1.02	1.05	1.05
36-36.9	1.04	1.04	1.04	1.07	1.04	1.07	1.04	1.04	1.04	1.07	1.07
37-37.9	1.06	1.06	....	1.09	1.06	1.09	....	1.06	....	1.09	1.09
38-38.9	1.08	1.08	....	1.11	1.08	1.11	....	1.08	....	1.11	1.11
39-39.9	1.10	1.10	....	1.13	1.10	1.13	....	1.10	....	1.13	1.13
40 and above	1.12	1.12	....	1.15	1.12	1.15	....	1.12	....	1.15	1.15

WEST TEXAS, PANHANDLE AND NEW MEXICO TABLE EXPLANATION

COLUMN (1):
Humble Oil & Refining Co., 5-21-41, includes Andrews, Crane, Crockett, Ector, Gaines, Glasscock, Howard, Reagan, Upton, Winkler, and Yoakum counties, West Texas, and Lea County, New Mexico.
Gulf Refining Co., 5-21-41, includes Crane, Ector, Upton, Ward, and Winkler counties, West Texas.
COLUMN (2):
Sinclair Prairie Oil Marketing Co., 5-21-41, includes West Texas and Lea County, New Mexico. Effective 5-29-41 in Eddy County, New Mexico.
Magnolia Petroleum Co., 5-21-41, includes Upton, Howard, Glasscock, Mitchell, Winkler, Cochran, Hockley, Yoakum and Gaines counties.
COLUMN (3):
Texas Co., 5-21-41, includes Crane and Winkler counties, Texas, and Lea County, New Mexico.
COLUMN (4) TEXAS PANHANDLE:
Magnolia Petroleum Co., 7-9-41.
Continental Oil Co., 7-9-41.
Phillips Petroleum Co., 7-9-41.
COLUMN (5) WINKLER AND LEA:
Stanolind Oil & Gas Co., 5-21-41, includes Winkler County only.
Gulf Refining Co., 5-21-41, includes Lea County, New Mexico, only.
COLUMN (6) GRAY COUNTY:
Texas Co., 5-21-41.
H. F. Wilcox Oil & Gas Co. (7-9-41).
COLUMN (7) LEA COUNTY:
Magnolia Petroleum Co., 5-21-41.
COLUMN (8) EDDY COUNTY:
Continental Oil Co., 5-30-41.
COLUMN (9):
Shell Oil Co., Inc., 5-20-41, includes Crane, Ector, Howard, Glasscock, Upton, Winkler, and Yoakum counties, Texas and Lea County, New Mexico.
COLUMN (10) TEXAS PANHANDLE:
Humble Oil & Refining Co., 7-9-41.
COLUMN (11) PANHANDLE:
Sinclair Prairie Oil Marketing Co., 5-23-41.

NORTH TEXAS, WEST CENTRAL TEXAS, EAST CENTRAL TEXAS GRAVITY TABLES

	1	2	3	4	5	6	7	8
Below 20	....	....	....	....	$.80	....	....	....
20-20.9	....	....	....	....	.82	....	....	....
Below 21	....	....	....	....	....	$.78	....	....
21-21.9	....	....	....	....	.84	.80	....	....
22-22.9	....	....	....	....	.86	.82	....	....
23-23.9	....	....	....	....	.88	.84	....	....
24-24.9	....	....	....	....	.90	.86	....	....
Below 25	....	....	$.88	....	....	....	$0.86	$0.95
25-25.9	$.88	....	.90	$.97	.92	.88	.88	.97
26-26.9	.90	....	.92	.99	....	.90	.90	.99
27-27.9	.92	....	.94	1.01	....	.92	.92	1.01
28-28.9	.94	$.94	.96	1.03	....	.94	.94	1.03
29-29.9	.96	.96	.98	1.05	....	.96	.96	1.05
30-30.9	.98	.98	1.00	1.07	....	.98	.98	1.07
31-31.9	1.00	1.00	1.02	1.09	....	1.00	1.00	1.09
32-32.9	1.02	1.02	1.04	1.11	....	1.02	1.02	1.11
33-33.9	1.04	1.04	1.06	1.13	....	1.04	1.04	1.13
34-34.9	1.06	1.06	1.08	1.15	....	1.06	1.06	1.15
35-35.9	1.08	1.08	1.10	1.17	....	1.08	1.08	1.17
36-36.9	1.10	1.10	1.12	1.19	....	1.10	1.10	1.19
37-37.9	1.12	1.12	1.14	1.21	....	1.12	1.12	1.21
38-38.9	1.14	1.14	1.16	1.23	....	1.14	1.14	1.23
39-39.9	1.16	1.16	1.18	1.25	....	1.16	1.16	1.25
40 and above	1.18	1.18	1.20	1.27	....	1.18	1.18	1.27

NORTH TEXAS, WEST CENTRAL TEXAS, EAST CENTRAL TEXAS TABLE EXPLANATION

COLUMN (1) WEST CENTRAL AND NORTH:
Humble Oil & Refining Co., 5-21-41, includes Brown, Callahan, Comanche, Eastland, Fisher, Haskell, Jones, Shackelford, Stephens, and Throckmorton counties.
Panhandle Refining Co., 5-21-41, in Leuders area.
Gulf Refining Co., 5-21-41.
COLUMN (2) NORTH TEXAS:
Continental Oil Co., 5-21-41.
Magnolia Petroleum Co., 5-21-41.
Panhandle Refining Co., 5-21-41.
Sinclair Prairie Oil Marketing Co., 5-21-41.
Bell Oil & Gas Co., 5-21-41.
Texas Co., 5-21-41.
COLUMN (3) EAST CENTRAL:
Magnolia Petroleum Co., 5-21-41, includes Cass, Panola, and Rodessa (Texas and Louisiana), and Miller County, Arkansas.
Gulf Refining Co., 5-21-41, includes Rodessa, Texas.
COLUMN (4) EAST CENTRAL:
Humble Oil & Refining Co., 5-21-41, includes Anderson, Cherokee, Limestone, and Navarro counties and the Navarro Crossing field.
COLUMN (5) EAST CENTRAL:
Humble Oil & Refining Co., 5-21-41, includes Hawkins field.
COLUMN (6) NORTH TEXAS:
Stanolind Oil Purchasing Co., 5-20-41.
COLUMN (7) FISHER COUNTY:
Shell Oil Co., Inc., 5-20-41.
COLUMN (8) MEXIA:
Sinclair Prairie Oil Marketing Co., 5-30-41.

TEXAS FLAT-PRICE FIELDS

Agua Dulce (light), Benavides, Longhorn, Southland, and Sweden, 5-21-41 ..... $1.35

(Continued on Next Page)

STANDARD OIL CO. OF CALIFORNIA

CRUDE-OIL PRICES EFFECTIVE MAY 23, 1941

(All gravities above those quoted take highest price offered in that field)

Gravity	Signal Hill (Long Beach)	Wilmington	(El Segundo)	Seal Beach	Huntington Beach	Inglewood	Playa Del Rey	Olinda-Brea Canyon	Athens-Rosecrans	Torrance	Richfield	Whittier East Coyote (La Habra)	Montebello	West Coyote Hills	Santa Fe Springs	Greeley, Canal, Wasco	Coles Levee	Mountain View	Elk Hills, Buena Vista Hills, Midway-Sunset, Lakeview area	Lost Hills	Coalinga	Wheeler Ridge	Kettleman Hills	Elwood Terrace
14-14.9	....	$.68	....	....	$.71	....	....	$.70	....	$.70	$.70	$.70	$.72	....	....	....	....	....	$.73	$.73	$.73	....	....	....
15-15.9	....	.71	....	....	.75	$.76	....	.72	....	.72	.71	.72	.72	....	....	....	....	....	.73	.73	.73	....	....	....
16-16.9	....	.74	$.79	....	.79	.79	....	.75	....	.74	.73	.75	.72	....	....	....	....	....	.73	.75	.73	....	....	....
17-17.9	....	.78	.82	....	.82	.82	....	.78	....	.77	.76	.78	.72	....	....	....	....	....	.75	.78	.73	....	....	....
18-18.9	$.80	.82	.86	....	.86	.85	....	.81	....	.80	.79	.82	.74	....	....	....	....	....	.78	.81	.73	....	....	....
19-19.9	.84	.86	.90	....	.89	.88	....	.85	....	.83	.82	.85	.77	....	....	....	....	$.73	.81	.84	.75	....	....	....
20-20.9	.88	.90	.94	....	.93	.92	$.80	.88	....	.86	.85	.89	.80	....	....	....	....	.76	.85	.87	.77	....	....	....
21-21.9	.92	.94	.98	....	.96	.95	.84	.91	....	.89	.89	.92	.84	....	....	....	....	.79	.90	.90	.80	....	....	....
22-22.9	.96	.98	1.02	$.88	.99	.98	.87	.95	....	.93	.93	.96	.87	....	....	....	....	.83	.94	.93	.83	$.76	....	....
23-23.9	1.00	1.02	1.05	.92	1.02	1.01	....	.98	....	.97	.98	1.00	.91	....	....	....	....	.87	.99	.96	.86	.80	....	....
24-24.9	1.03	1.06	1.07	.97	1.05	1.04	f.o.b.	1.01	....	1.01	1.02	1.03	.94	$.99	....	....	....	.90	1.03	.99	.89	.83	....	....
25-25.9	1.07	1.09	1.10	1.01	1.08	1.07	our	1.04	....	1.05	1.06	1.07	.98	1.02	....	....	....	.94	1.07	1.01	.92	....	....	....
26-26.9	1.11	1.12	1.12	1.06	1.11	1.10	pipe	1.08	....	1.09	1.10	1.11	1.01	1.06	....	....	....	.97	1.11	1.04	.95	....	....	....
27-27.9	1.15	1.15	1.15	1.10	1.14	1.14	line	1.11	....	1.13	....	1.15	1.05	1.10	$1.04	....	....	1.01	1.15	1.07	.98	....	....	....
28-28.9	1.18	1.18	1.18	1.15	1.17	1.17	....	1.14	....	1.17	....	....	1.08	1.13	1.08	....	....	1.04	1.19	1.10	1.00	....	....	....
29-29.9	1.20	1.21	....	1.19	1.20	1.20	....	....	$1.17	....	....	....	1.12	1.17	1.12	....	....	1.07	1.24	1.13	1.02	....	....	....
30-30.9	1.23	1.24	....	....	1.23	1.22	....	....	1.21	....	....	....	1.15	1.21	1.15	$1.01	$1.09	1.10	1.28	1.16	1.04	....	....	f.o.b.
31-31.9	....	....	....	....	....	1.24	....	....	1.25	....	....	....	1.19	1.24	1.19	1.04	1.12	1.14	....	....	1.06	....	....	ship
32-32.9	....	....	....	....	....	....	....	....	1.29	....	....	....	1.23	1.28	1.23	1.07	1.14	1.17	....	....	1.09	....	....	....
33-33.9	....	....	....	....	....	....	....	....	1.32	....	....	....	1.27	....	1.26	1.10	1.17	....	....	....	1.11	....	....	$1.22
34-34.9	....	....	....	....	....	....	....	....	1.36	....	....	....	1.31	....	1.30	1.13	1.20	....	....	....	1.13	....	....	1.25
35-35.9	....	....	....	....	....	....	....	....	....	....	....	....	1.35	....	....	1.16	1.22	....	....	....	....	....	$1.23	1.28
36-36.9	....	....	....	....	....	....	....	....	....	....	....	....	1.39	....	....	1.19	1.25	....	....	....	....	....	1.26	....
37-37.9	....	....	....	....	....	....	....	....	....	....	....	....	1.43	....	....	1.22	....	....	....	....	....	....	1.29	....
38-38.9	....	....	....	....	....	....	....	....	....	....	....	....	1.47	....	....	1.25	....	....	....	....	....	....	....	....
39-39.9	....	....	....	....	....	....	....	....	....	....	....	....	1.51	....	....	....	....	....	....	....	....	....	....	....
40-40.9	....	....	....	....	....	....	....	....	....	....	....	....	1.53	....	....	....	....	....	....	....	....	....	....	....

Standard posts 73 cents for all grades at Newhall, Kern River, Kern Front, McKittrick and Round Mountain.

Leasing Heavy at Warren County Wilcox Showing

By R. MARNE SANFORD

JACKSON, Miss., Nov. 3. — Magnolia Petroleum Co. 1 Hall, previously indicated low-gravity discovery well for Warren County, is drilling deeper some 600 ft. below the show found 2 weeks ago. Hopes are still held for further and more prolific production at a deeper level on the Warren County structure. The test, located in NW SE 39-17n-4e, had found shows of oil at 2,199 ft. However, the best gage showed only 10 bbl. of oil daily with 1,000 bbl. of water. It is now below 2,659 ft. and still in the Wilcox section. The well is still being closely watched because it resulted in the first oil shows from the Wilcox section ever discovered in the State of Mississippi.

The mounting wave of lease and blocking work that developed following the news of the oil show, has been affected only slightly by the fact that it proved noncommercial. Three townships around the test, that is 15n-4e and 16 and 17n-5e, are leased almost solid. Some companies are playing the salt dome theory and are taking the majority of their acreage as much as 4 and 5 miles from the Magnolia test, hoping to be down the flank of the structure and thus be over deeper production. Whether it is a salt dome or a structural anticline is not yet known.

SUMMARY OF COMPLETIONS

Mississippi

	No.	Bbl.	Footage
Oil wells: Tinsley	6	2,580	29,798
Dry holes: Tinsley	1	.....	6,805
Total	7	....	36,603

Deep Test Likely in Lawrence County, Mississippi

Last week Alabama's deep 12,399-ft. wildcat in Clarke County was abandoned as dry but geological markers have still not been released by the company. As the past week closed it appeared that a deep test was in the making for Lawrence County, Mississippi. Tide Water Oil 1 Denkman Lumber Co., SW 5-5n-11e, was drilling ahead below 10,132 ft. with contract depth not set. The wildcat is located on a seismograph prospect and geological conditions must be proving favorable for an electrical survey was made at 9,495 ft. and deeper drilling was decided upon.

In Copiah County a wildcat is drilling ahead in the lower Wilcox section and expecting the top of the Midway any time. No oil shows have been found in the Wilcox section. It is Sun Oil 1 J. G. Ainsworth, N½ NW SE 17-9n-7e, on a seismograph prospect. There was a possibility when the test started that it would be carried to 10,000 ft. It is drilling below 6,962 ft.

Wildcats Preparing to Start

In Issaquena County, a wildcat staked several weeks ago, is preparing to get under way. It is John Gholson and Jess Bohon 1 Oden, NW NE 31-9n-6w. It has been rigging up for several weeks. In Union County, P. J. McAlpine and J. E. Dickson have a rig on location for

(Continued on Page 239)

Canadian Fields

(Continued from Page 210)

November 20. Acreage has been reported on by Dr. George S. Hume of the Geological Survey of Canada and Dr. J. O. G. Sanderson. The Sarcee reserve is north and west of North Turner Valley and in line with the trend of that structure; and indications point to a potential field extending 15 miles with production in the Madison limestone within 7,000 ft. and well above the water line indicated in Turner Valley. In the same field, Inland Development 1, LSD 2, 4-23-4w5, south and west of Petroleum Corp. 1, is preparing to resume from 1,300 ft.

East-Central Alberta

Systematic development and utilization of shallow crude areas in east-central Alberta is being undertaken by a number of companies as a result of the demand for fuel oil for the transcontinental railroads. The potential fields lie between the Viking gas field and the Saskatchewan boundary, and include the Vermilion-Battleview area, the Lloydminster field, 25 miles farther east, the Dina-Ribstone and Wainwright areas, 30 miles south of Vermilion, the Claysmore area 6 miles west of Vermilion and the Derwent area 25 miles north. The most successful development so far has been in the Vermilion area itself where Vermilion Consolidated Oils has recently merged a number of smaller companies and is undertaking extensive new development. Anglo-Canadian Oil 1, LSD 15, 28-49-7w4, is below 1,003 ft. This company will concentrate largely on the Claysmore area, where Imperial Oil also holds extensive acreage. W. F. Thorne and associates have purchased a batch still refinery at Kindersley, Saskatchewan, and are moving it to Borradaile, just east of Vermilion, where they will heat-process the oil to remove water and silt, for sale to the railways as fuel oil. Western Drilling Co. is also finishing a treating plant. While the immediate objective is development of a fuel oil supply, more extensive processing may be undertaken if a large production is shown.

Alvinston Shallow Field

A new shallow crude area has been developed recently in the eastern part of Lambton county, where a test drilled by a Toronto syndicate on the Hugh McIntyre farm, 6 miles south of Alvinston, made 22 bbl. daily. Two earlier completions on the adjoining Lachlan McLean farm are making 2 and 5 bbl. daily; and there are 13 producers on the James Shield farm. The crude is hauled in tank trucks to Bothwell for shipment to the refineries.

Crude-Oil Prices

(Continued from Preceding Page)

Agua Dulce (heavy), 10-16-41 ....$1.25
Republic Oil Refining Co., 5-21-41.
Alfred and Magnolia City $1.35
Continental Oil Co., 5-21-41.
Alice, Benavides (North Sweden), Ben Bolt, Clark-Muil, Sun, and Tom Graham $1.35
Humble Oil & Refining Co., 5-21-41.
Batson (new), Humble (35° and above), Fig Ridge, Hardin, Hull (25° and above), La Belle, North Dayton (25° and above), Seabreeze South China, West Orange, Willow Slough and Oyster Bayou..$1.25
Sun Oil Co., 5-21-41.
Cass County $1.20
Texas Co., 5-21-41.
Cayuga, Anderson County $0.90
Pan American Production Co., 5-21-41.
Clay Creek, Washington County ...$1.00
Sun Oil Co., 5-21-41.
Cleveland, Liberty County $1.26
Magnolia Petroleum Co., 5-21-41.
Conroe, Montgomery County $1.43
Humble Oil & Refining Co., 5-21-41.
Tide Water Associated Oil Co., 5-21-41
Sun Oil Co., 5-21-41.
Texas Co., 5-21-41.
Cotton Lake (South) $1.35
Sun Oil Co., 5-21-41:
East Texas and Flag Lake* $1.25
**Humble Oil & Refining Co.*, 5-21-41.
Pan American Production Co., 5-21-41
Tide Water Associated Oil Co., 5-21-41
Gulf Refining Co., 5-21-41.
Magnolia Petroleum Co., 5-21-41
Sinclair Prairie Oil Marketing, 5-21-41.
Shell Oil Co., Inc., 5-20-41.
Sun Oil Co., 5-21-41.
Texas Co., 5-21-41.
Stanolind Oil Purchasing Co
Esperson (35° and above), South Esperson $1.30
Sun Oil Co., 5-21-41.
Flour Bluff, East Flour Bluff $1.33
Humble Oil & Refining Co., 5-21-41.
Hockley and Cochran $0.87
Texas Co., 5-21-41.
Livingston $1.25
Shell Oil Co., Inc., 5-20-41.
Long Lake $1.23
Sinclair Prairie Oil Marketing, 5-21-41.
Luby $1.35
Amsco Pipe Line Co., 5-21-41.
Luling $1.05
Magnolia Petroleum Co., 5-21-41.
Lytton Springs $1.17
Magnolia Petroleum Co., 5-21-41.
Salt Flat, North Salt Flat, Darst Creek*, Hilbig, Clark, Carroll, and Zoborski $1.14
Humble Oil & Refining Co., 5-21-41.
Magnolia Petroleum Co., 5-21-41.
**Texas Co.*, 5-21-41.
Rincon (North) $1.35
Sun Oil Co., 5-21-41.
Sun $1.35
Sun Oil Co., 5-21-41.
Talco $0.79
Humble Oil & Refining Co., 5-21-41.
Magnolia Petroleum Co. 5-21-41.
Tomball and Satsuma $1.40
Humble Oil & Refining Co., 5-21-41.
**Magnolia Petroleum Co.*, 5-21-41.
Stanolind Oil Purchasing Co., 4-1-41.
Van, Van Zandt County $1.08
Humble Oil & Refining Co., 5-21-41.
Pure Oil Co., 5-21-41.
Yates (regular) $0.95
Humble Oil & Refining Co., 5-21-41.
Gulf Refining Co., 5-21-41.
Shell Oil Co., Inc., 5-20-41.
Yates (shallow) $0.82
Shell Oil Co., Inc., 5-20-41.

Kentucky

Ashland Oil & Transportation Co., 6-19-41:
Big Sandy River $1.38
Kentucky River 1.43
Sohio Corp., 5-21-41:
Birk City $1.15

Montana

Continental Oil Co., 4-1-41:
Cat Creek $1.15

Colorado

Stanolind Oil & Gas Co., 5-20-41:
Iles $1.07
Continental Oil Co., 5-21-41:
Canon City-Florence $1.05

Canadian Fields

Imperial Oil, Ltd.:
Petrolia, 11-6-39 .....$2.10
Oil Springs, 11-6-39 .....2.07
Bothwell, 11-6-39 .....2.10
Turner Valley, 7-16-41 .....$1.35-1.97

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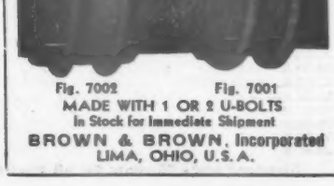

Fig. 7002 Fig. 7001
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MARKET RECORD OF ACTIVE OIL STOCKS . . .

Compiled by Carl H. Pforzheimer & Co., 25 Broad Street, New York City. Member New York Stock Exchange and New York Curb Exchange

New York Stock Exchange

1941 High	1941 Low	Week ended Nov. 1 High	Week ended Nov. 1 Low	Week ended Nov. 1 Close	Stocks—	Total shares outstanding	Par value	Latest dividend	Payable or last paid	Dividends paid in 1940	Com. sh. earn. 1940	Com. sh. earn. 1939	1940 High	1940 Low	1939 High	1939 Low
63½	44	57	57	57	Amerada Corp.	788,675	N.P.	50cQ	10-31-41	$2.00	$2.25	$1.56	58½	38½	74½	50
26⅞	19½	26⅞	24¾	26½	Atlantic Refining	2,663,999	$25	$1.25†	12-15-41	1.00	2.11	1.66	27⅛	18¼	24⅝	18⅛
13⅛	7	12⅛	11½	12	Barber Asphalt Co.	390,223	$10	25c	5-21-40	.50	—.48	1.39	16⅝	8½	21	10¼
10½	7⅝	10⅛	9½	9⅝	Barnsdall Oil Co.	2,558,779	$5	15c	12-8-41	.60	.97	.76	13⅜	7⅛	19½	11⅛
6½	5¼	6⅛	6	6⅛	Consolidated Oil Corp.	13,751,726	N.P.	12½cQ	11-15-41	.72½	.28	.55	8⅛	5½	9⅞	6½
26¾	17⅜	26¼	25⅝	26	Continental Oil of Delaware	4,682,572	$5	25cQ	9-29-41	1.00	.92	1.35	25	16⅛	31½	19⅞
5	3½	4⅛	4	4⅛	Houston Oil	1,098,618	$25		10-17-30		.30	.43	6⅞	3⅜	9⅜	4½
13⅜	9⅝	12½	11⅜	11¾	Lion Oil Refining	435,815	N.P.	25cQ	10-15-41	1.00	1.05	1.50	14⅜	9	18⅛	10
17⅞	13	17⅜	16⅝	16½	Mid-Continent Petroleum	1,857,912	$10	75c	12-1-41	.80	1.60	1.42	17⅜	11½	18	11⅛
14⅜	9⅜	15½	14¼	14⅜	Mission Corporation	1,378,645	$10	60c	10-16-41	.25	1.01	.87	11¾	7⅛	14⅞	8¾
7⅞	4¼	6⅞	6⅛	6¼	National Supply	1,155,517	$10		12-22-37		—.49	—.87	9¾	4⅝	15½	5⅝
10	6¾	9⅛	8⅝	8⅞	Ohio Oil Co.	6,563,377	N.P.	25c	12-15-41	.45	1.02	—.10	8¾	5⅜	10½	6
9¾	5½	8¾	8⅛	8⅛	Pacific Western Oil	1,000,000	N.P.	40c	12-19-39	....	—.21	.81	8⅞	5½	11⅞	7
10½	7¼	..	..	..	Pan American Pet. Trans.	4,702,945	$5	25c	12-21-40	.25	1.20	1.10	10½	6¾	8¾	5
46	35¾	44⅞	44¼	44⅞	Phillips Petroleum	4,449,052	N.P.	†75c	11-29-41	2.00	2.60	2.21	41¾	27⅛	46½	31¼
17	14¼	16⅝	16⅛	16¼	Plymouth Oil Co.	1,038,633	$5	30c	9-30-41	‡1.30	1.38	2.38	22¾	15	24	17⅛
10⅞	7	10¾	10½	10¾	Pure Oil Co.	3,982,031	N.P.	50c	12-1-41	.25	1.21	1.11	11½	6¾	11¾	6⅛
12⅛	7¼	10¼	10¼	10¼	Richfield Oil Corp.	4,010,000	N.P.	50c	12-21-40	.50	.95	.65	9¼	5⅞	10¼	6⅝
17	12½	14¼	13¼	13½	Seaboard Oil of Delaware	1,244,383	N.P.	25cQ	9-15-41	1.00	1.05	1.40	20	11	24⅝	15½
15¾	10⅛	15¼	14¾	14⅞	Shell Union Oil	13,070,625	N.P.	40c	7-21-41	.75	1.05	.77	13⅛	7⅝	17¼	9⅞
35¼	18⅞	35¼	34⅜	34⅞	Skelly Oil	995,349	$15	$1.00	12-18-41	1.25	3.28	1.99	23¼	12¼	29½	15½
10¾	8¼	10⅛	9¾	10	Socony-Vacuum	31,206,071	$15	25cSA	9-15-41	.50	1.17	1.10	12½	7⅛	15⅛	10¼
24⅝	17⅞	23⅞	22¾	23⅞	Standard Oil of California	13,003,953	N.P.	†65c	12-15-41	1.00	1.73	1.38	26⅛	16¼	33⅝	24¼
34⅛	25½	33	32	33	Standard Oil (Indiana)	15,272,020	$25	50c†	12-15-41	1.50	2.20	2.23	29	20¾	30	33¾
45⅝	33	43⅞	42⅞	43⅞	Standard Oil of New Jersey	27,280,998	$25	1.00†	6-16-41	1.75	4.54	3.26	46½	29⅞	53½	38
48½	34¼	41¾	40½	41¼	Standard Oil of Ohio	753,740	$25	75c†	9-15-41	2.00	7.44	6.64	41¾	26¼	32¾	17
60½	50	59¾	59	59¾	Sun Oil	2,434,863	N.P.	25cQ	12-15-41	*1.00	3.03	2.74	65⅞	46¾	66	45¾
2⅜	1⅜	1⅞	1¾	1¾	Superior Oil Corp.	1,388,979	$1	10c	12-28-40	.10	.11	.04	2½	1⅛	3⅝	1¾
44¾	34½	44⅜	42½	42⅞	Texas Corp.	10,876,139	$25	50cQ	10-1-41	2.00	2.90	3.02	47⅝	33	50¾	32½
4⅛	2⅞	3⅛	3	3	Texas Gulf Producing Co.	888,147	N.P.	10c	6-14-41	.20	.63	.69	4¼	2½	5⅝	3¼
7¾	5¼	7	6½	6½	Texas Pacific Coal & Oil	888,236	$10	10c	12-1-41	.40	.54	1.00	8⅝	5⅜	11⅜	7
11¼	9⅜	11¼	10⅞	11⅛	Tide Water Associated	6,371,827	$10	25c†	12-1-41	.70	1.14	1.05	12	8¾	14¼	9½
16	12¾	14⅞	14½	14¾	Union Oil Co. of California	4,666,270	$25	25c	11-10-41	1.00	.99	1.25	17½	17	19¾	15⅛
31	25	26½	25⅞	26⅛	Union Tank Car Co.	1,177,381	N.P.	50c	9-2-41	1.75	2.22	2.07	29⅞	22¾	24¼	20⅛
2⅜	1⅝	2⅛	2	2⅛	Wilcox Oil & Gas	170,768	$5	10c	2-15-40	....	.35	.77	3⅝	1¾	4¼	2⅜

*Also 5 per cent in stock. †Includes extras. Also 2 per cent in stock. —Deficit.

New York Curb Exchange

1941 High	1941 Low	Week ended Nov. 1 High	Week ended Nov. 1 Low	Week ended Nov. 1 Close	Stocks—	Total shares outstanding	Par value	Latest dividend	Payable or last paid	Dividends paid in 1940	Com. sh. earn. 1940	Com. sh. earn. 1939	1940 High	1940 Low	1939 High	1939 Low
¾	¼	7/16	¼	7/16	American Maracaibo Co.	1,778,415	$1	....	....	....	—$0.04	—$0.05	11/16	¼	1¼	¼
8¼	5⅛	7⅛	6¾	6¾	American Republics Corp.	1,308,049	$10	10c	7-10-41	....	.78	.14	10¾	4½	11⅝	5½
2½	1	2	1⅞	1⅞	Bridgeport Machine Co.	263,700	N.P.	$1.25	12-30-37		—.88	—.95	3¼	1⅜	7¼	2½
46	36½	44¾	43	44¾	Buckeye Pipe Line Co.	200,000	$50	$1	12-15-41	$4.00	5.09	3.13	43	28	34¾	26½
110¼	87	..	..	..	Chesebrough Mfg. Co.	120,000	$25	$1.50Q†	9-29-41	6.00	6.33	7.87	117	95	130	108⅝
6⅝	3⅝	4	3⅝	3¾	Cities Service (new)	3,703,978	$10	..	6-1-32	..	1.72	.68	6¾	4	9¼	4¼
2	⅝	1⅝	1½	1½	Cosden Petroleum	465,804	$1	..			—.34	.15	2⅛	⅝	2¼	½
19¾	12½	18⅜	17½	18	Creole Petroleum	6,974,356	$5	50cSA†	6-16-41	1.00	.98	1.38	24¼	11⅝	28	16¾
9	3¾	9	8¼	8⅞	Darby Petroleum	351,390	$5	25c	7-15-41	....	1.12	.03	4⅜	2⅞	7⅛	3⅝
2¼	1	1¾	1⅝	1¾	Derby Oil & Refining	263,162	N.P.				.12	—.37	2	¾	2⅝	1½
28¾	20	..	..	..	Eureka Pipe Line	50,000	$50	50c	11-1-41	2.25	—.49	.63	31	20¼	23	15⅛
39	29	36	35	35⅝	Gulf Oil Corp.	9,076,202	$25	25cQ	10-1-41	1.25	2.44	1.69	39⅞	25⅛	45⅛	29¼
65	52¾	61	60	60½	Humble Oil & Refining	8,987,840	N.P.	62½c	10-1-41	2.00	3.13	3.33	68	47⅛	71	42½
7⅝	5⅝	7	6¾	6¾	Imperial Oil of Canada	26,965,078	N.P.	25c	6-2-41	.62½	.65	.71	12⅝	5⅝	17	11⅜
5	2¾	4	3¾	3¾	Indiana Pipe Line	300,000	$7.50	20c	11-15-40	*2.80	.09	.33	7¾	3	7¼	5½
11⅞	8⅞	11½	11¼	11⅜	International Petroleum	14,324,088	N.P.	50c	6-2-41	1.25	.94	1.19	10⅜	8¼	27½	17
2⅝	1⅜	2	2	2	Kirby Petroleum Co.	500,000	$1	10c	3-15-41	....	.16	.06	2¾	1⅝	3¾	2⅛
10⅛	8⅜	8½	8⅛	8¼	Lone Star Gas	5,518,347	N.P.	20c	8-22-41	.70	1.17	.98	10⅜	7⅝	10½	7⅛
5⅝	4⅛	4⅝	4⅜	4⅜	Louisiana Land & Exp.	2,966,762	$1	10c	9-15-41	.35	.29	.22	6¼	3¾	7⅝	4
10⅛	9½	10⅛	10⅛	10⅛	Margay Oil Corp.	149,943	N.P.	25cQ	10-10-41	1.00	1.02	1.52	17	9¼	17	14½
4⅛	2½	3½	3¼	3¼	Middle States Petroleum "A"	291,970	$1	37c	1-31-41	.63	.31	.37	4⅛	2¾	5¾	2¾
8	7	7¾	7⅝	7⅝	Midwest Oil Co.	998,474	$10	45c	12-15-41	.90	.88	.99	8½	5½	8¾	6⅝
6⅛	5⅛	5⅝	5⅛	5⅜	Mountain Producers	1,593,584	$10	30cSA	6-16-41	.60	.58	.70	6¼	4⅞	6	4⅞
12⅜	10⅛	10¾	10⅜	10⅜	National Fuel Gas	3,810,183	N.P.	25cQ	10-15-41	1.00	1.12	.95	13⅛	10	14	11¼
12⅞	10¼	11⅜	11⅜	11⅜	National Transit	509,000	$12.50	50c	6-16-41	1.00	1.08	.91	12½	8¾	9½	7¼
2¼	1	1⅜	1⅜	1⅜	New Mexico and Arizona	1,000,000	$1	1c	12-1-37	....	.03	.02	1¼	¾	1¾	1
8¼	6⅝	..	..	..	New York Transit	100,000	$5	30c	10-15-41	.60	.91	.88	7¾	5¼	6	4
9¾	7¾	..	..	..	Northern Pipe Line	120,000	$10	90c	12-1-41	.80	.70	.31	9⅞	6	7	4½
5½	2⅝	5½	5⅛	5¼	Pantepec Oil	2,856,872	$1	....	....	....	.02	....	5½	2½	7⅝	4
3¾	1	3	2¾	2¾	Root Petroleum Co.	336,045	$1	25c	2-1-37	....	.04	.70	3¼	1	5	1¼
2⅝	2⅛	..	..	..	Ryan Consolidated	298,931	N.P.	10c	12-28-40	....	.43	.16	3	1¼	3	1⅞
8	6½	..	..	..	Southern Pipe Line	100,000	$10	25c	9-2-41	.50	.81	.25	11¾	4¾	4⅞	3½
43½	35⅝	36¾	36	36⅝	South Penn Oil	1,000,000	$25	37½c	9-26-41	2.50	2.10	2.84	44	28	40½	26¾
30½	23	..	..	..	Southwest Penna. Pipe Lines	35,000	$50	50c	10-1-41	6.50	3.22	2.06	35	21	23	18
20⅜	17⅞	19⅜	19	19	Standard Oil of Kentucky	2,604,790	$10	25c	9-15-41	1.30	1.47	1.53	20⅞	16½	20¼	17¼
2¼	1⅜	2¼	2	2⅛	Sunray Oil	1,975,876	$1	5c	12-20-40	.10	.23	.25	2	1⅜	2¾	1¾
3¼	2⅝	3	3	3	Texon Oil & Land	936,024	$2	10c	9-26-41	.40	.45	.49	3⅛	2	4	2⅝
4⅝	2¼	4⅞	4⅜	4⅞	Transwestern Oil Co.	750,000	$10	....	.....	....	—.59	—1.42	3¾	2	6	2½
11/16	½	9/16	½	½	United Gas Corp.	7,818,959	$1	....	.....	....	—.49	—.55	2⅛	¾	3⅜	1½

*Includes $2.50 capital distribution. †Includes extras. —Deficit.

Personal Paragraphs

C. B. WILLIAMS, who has been in charge of the Barco concession in Colombia for the Texas Co., has returned to the United States and is now division manager at Fort Worth, Tex., for the company. He succeeds H. S. COLE, JR., now assistant to L. F. BARROWS, manager of the producing division.

F. L. NEWCOMB, Standard Oil Development Co., Elizabeth, N. J., has been appointed member of the American Petroleum Institute's committee on corrosion of refinery equipment. He succeeds R. L. DUFF, resigned. A. L. WEIST, manager of the lubricants department of Shell Oil Co., Inc., San Francisco, Calif., has been appointed to the Institute's lubrication committee.

CHARLES H. SNELSON has been named manager of the Illinois-Indiana office of Seaboard Oil Co., with station at Mount Vernon, Ill.

J. C. (RED) WELLS, of Shreveport, La., formerly with Haynes Producing Co., is now superintendent of production for United Producing Co., Inc., with headquarters at Cisne, Ill.

FRANK R. WEBSTER has been elected president of Highwood-Sarcee Oil Co., Calgary, Alta., Canada. R. G. STRAKER was named managing director, and H. H. BRADBURN, P. J. TIMMS and W. ACKLAND were made directors.

CHARLES I. ROUNTREE, veteran driller who recently returned to the United States from Iraq, where he had been employed for 14 years with Standard Oil Co., has decided to settle down on his ranch in western Williamson County, Texas, and raise cattle.

VAN D. ROBINSON, formerly assistant district geologist in the North Louisiana and Arkansas area for Atlantic Refining Co., has been named district geologist. He succeeds SAM M. ARONSON, who last week resigned his post. The company's offices are at Shreveport, La.

E. E. PYLES, vice president of Hancock Oil Co. and chairman of the production committeee for District 5, and his committee, are again in session at Los Angeles, Calif., attempting to work out a curtailment plan that will meet with approval of the coordinator and the Department of Justice.

W. H. EATON, JR., has been appointed general sales manager of Shell Oil Co., Inc., to succeed RALPH H. ERICHSEN, resigned. Announcement of the appointment was made by L. T. KITTINGER, vice president in charge of marketing. At the same time M. H. NABORS was named assistant manager of the lubricants department.

J. E. BRANTLY, of Los Angeles, Calif., president of Drilling & Exploration Co., was principal speaker for the Petroleum Engineers Club at a luncheon held at the Dallas Athletic Club last week. Mr. Brantly, who has spent much time in South America, discussed operating conditions in South American oil fields, problems met by drillers, and how the problems were solved.

E. R. ATWILL, research geologist for Union Oil Co., has been elected secretary-treasurer of the Pacific section, American Association of Petroleum Geologists. Mr. Atwill has been associated with Union Oil since his graduation from Stanford University in 1927. Starting as a junior draftsman in the geological department, he was later stationed in Bakersfield as division geologist prior to assuming his present position with the company.

ROBERT L. HAZLETT, of Casper, Wyo., has been appointed secretary to the general committee of the petroleum coordinator with headquarters in Denver, Colo. W. H. FERGUSON, vice president, Continental Oil Co., is general chairman. ROBERT M. SEARS, of Inland Empire Refineries, Inc., Spokane, Wash., has been given a leave of absence to engage in statistical and research work for the refining committee, and is now located in Denver.

Do You Remember?

From The Oil and Gas Journal Files

25 YEARS AGO

Last week, in Tulsa, a young man tried to organize a syndicate to corner fuel oil. After causing a sensation as a high-finance exploiter, he was taken to a sanitarium for mental treatment.

For some time, in the Mid-Continent field, there has been a newspaper campaign in behalf of increased oil prices. . . . (They) seem to have taken root in barren soil and do not grow upward.

John G. Lamont, 47, European manager of Pure Oil Co., died at the Rockefeller Institute, New York City, November 21. He was also vice president of the International Petroleum Co. of Canada.

20 YEARS AGO

A plan (sponsored by W. D. Cline, president of the Texas-Louisiana division of the Mid-Continent Oil and Gas Association) is to teach geology, production, manufacturing and distribution methods in higher institutions of learning.

William Frank Potter, vice president of the Petroleum Publishing Co. and editor of The Oil and Gas Journal, died October 28 at his home in Tulsa. He is survived by his wife, two sons, Paul and Harry, and a daughter, Mrs. Florence Hanawalt.

An unprecedented number of wildcat oil wells are drilling in Illinois. Fifteen are reported at this time.

10 YEARS AGO

Gov. Ross Sterling (Texas) told Charles F. Roeser and the oil committee presenting the acreage unit production plan for East Texas that he "believes it can and will be put into effect."

A concrete tunnel under the Houston Ship Channel, which will provide a permanent conduit for pipe lines crossing the channel, was completed by the Sinclair Texas Pipe Line Co.

W. J. KLECKNER, who had charge of drilling in Michigan for Gulf Oil Corp., has been transferred to Fairfield, Ill.

JOHN MURRELL, formerly with Shell Oil Co., Inc., in East Texas, has been appointed as conservation engineer for District 3, with headquarters in Houston, Tex.

C. O. RISON, for many years superintendent at Oklahoma City, Okla., for I.T.I.O. before the merger with Cities Service, has resigned and has entered sales work.

EDWIN MOTT has been elected vice president and director of Esso Marketers, taking the posts vacated by J. WALTER SAYBOLT, who retired recently. Mr. Mott joined the Standard Oil Co. of New Jersey in 1919.

ANGUS CRITES, San Joaquin Valley oil producer, has returned home following attendance at the annual meeting of the Independent Petroleum Association held at Tulsa. Mr. Angus drove back to Los Angeles and Bakersfield, Calif.

L. H. FREEDMAN, chief geologist for Snowden & McSweeney Co., at Fort Worth, Tex., for the past 22 years has resigned effective as of November 1. Mr. Freedman will remain in the oil business as an independent operator with headquarters in Fort Worth.

C. E. BUCHNER, executive manager of the Independent Petroleum Association of America, addressed the Rotary Club of Tulsa last week. He discussed the necessity of wildcatters in the oil business being kept in business through a favorable priority rating and an adequate price.

BASIL G. JOHNSON is now manager of the Walters district of Community Gas Co. He replaces J. A. HAYES, transferred to Wichita Falls, Tex., as plant superintendent.

C. K. SEAMAN, district petroleum engineer in the Chalkley, Tex., district for Humble Oil & Refining Co., has been transferred to the Bayou des Glaise district.

W. A. DRAKE, repressuring-plant foreman for the Humble Oil & Refining Co., has been appointed gasplant superintendent in charge of the Flour Bluff, Tex., gasoline plant.

H. G. FROST, W. D. DUNNAM, and NOLAN ELAM, independent operators of Houston, Tex., have formed the Frost & Dunnam, Inc., with offices at Houston, Tex.

R. A. THOMPSON, district chief clerk for Humble Oil & Refining Co., has been transferred from the Tomball (Texas) Natural Gas System to the Lovells Lake repressure plant.

DOUGLAS D. HOWARD has resigned as petroleum geologist with Arkansas Fuel Oil Co., Shreveport, La., and is now associated with Penrod Drilling Co., Dallas, Tex.

GALE BILLINGS, Colorado City, Tex., area engineer for the Shell Pipe Line Co., has been transferred to Healdton, Okla. J. K. ALRED, recently of Houston, Tex., will replace Mr. Billings.

FRANK C. SMITH, president of the Houston Natural Gas Corp., Houston, Tex., has been elected chairman of the board of the directors of the Texas College of Arts and Industries at Kingsville, Tex.

ROBERT J. BEZETTE, of the refining division of Standard Oil Co. of Louisiana, Baton Rouge, was honoree at a dinner given him by the refinery employes of the company on the occasion of his retirement on a life annuity at age 65.

R. L. BABCOCK, who has been drilling for the British Petroleum Co. in Iraq for several years, has returned to his home in Whittier, Calif., after a journey of 4 months trying to get home from Bagdad and other adjacent points.

General Manager

W. C. Whaley, who succeeded R. A. Broomfield as general manager of California operations of Barnsdall Oil Co. on November 1, 1941, is a native Californian, born in Santa Maria on April 29, 1894, whose first job was in the oil fields and who has been in the oil industry ever since. Mr. Whaley joined Barnsdall under Fred A. Fortine, as a driller, in 1924. During his period of service with the company, he has been drilling foreman, field superintendent, general superintendent, vice president and general superintendent, and now, with the retirement of Mr. Broomfield from active service, vice president and general manager of California operations. He has been a Barnsdall director since 1940.

W. C. WHALEY

In addition to being vice president and general manager of his company for California, Mr. Whaley is president of the California Petroleum Safety Board, a cooperative safety group of independent oil companies; is a member of the Production Committee for District No. 5 under the Office of Petroleum Coordinator for National Defense; is a past chairman of the drilling-practices committee of the American Petroleum Institute, and has been active in the voluntary conservation program of the California oil industry since its inception in 1929.

His first job was with the Commercial Oil Co. in Coalinga as a roustabout in 1911. Prior to this time, Mr. Whaley worked in the oil fields of the San Joaquin Valley for various companies while he was still attending school. His first important job was with the Honolulu Oil Co. in 1912, under the same Fred A. Fortine who later hired him for the Barnsdall Oil Co. From 1915 to 1924, with the exception of 2 years spent in the U. S. Army overseas, Mr. Whaley worked for various oil companies in California, Wyoming, Oklahoma, Texas, Montana, and Kentucky, and spent 2 years in the British West Indies.

Mr. Whaley married Miss Jo Eakin in Taft, Calif., in 1921, and they now have two sons. His hobbies are hunting and fishing, particularly the former. He attended school in Bakersfield and Coalinga, and is a Shriner and a member of the California Club.

ROY B. RALSTON is a new member of the Illinois-Indiana basin scouting staff of Skelly Oil Co., with offices at Evansville, Ind.

STEFAN VON CROY, chief geophysicist for Barnsdall Oil Co. at Houston, Tex., has been transferred to Tulsa headquarters.

E. W. ANGUISH, West Texas oil operator, has reopened his oil office in Midland, Tex. He closed the office 3 years ago because of ill health.

T. M. ROPER, division clerk for the Humble Oil & Refining Co., has been appointed division material pusher in the West Texas division.

N. F. HENDERSON, district petroleum engineer in the Magnet, Tex., district, for Humble Oil & Refining Co., has been transferred to the Friendswood district.

FRANK STICKLE, of Mabee Oil & Gas Co., Tulsa, will address the first annual meeting next week of the American Association of Oil Well Drilling Contractors, in Dallas, Tex.

MARTIN R. WARREN, who has served for 25 years as pumper for the Texas Co., at Humble, Tex., has been retired. The occasion was marked by a party given him by fellow employes.

EMBY KAYE, head of Distillate Engineering & Process Co., Tulsa, and an authority on recycling of gas-distillate wells, addressed the Tulsa Geological Society last week on "Recent Surveys of Recycling Activities."

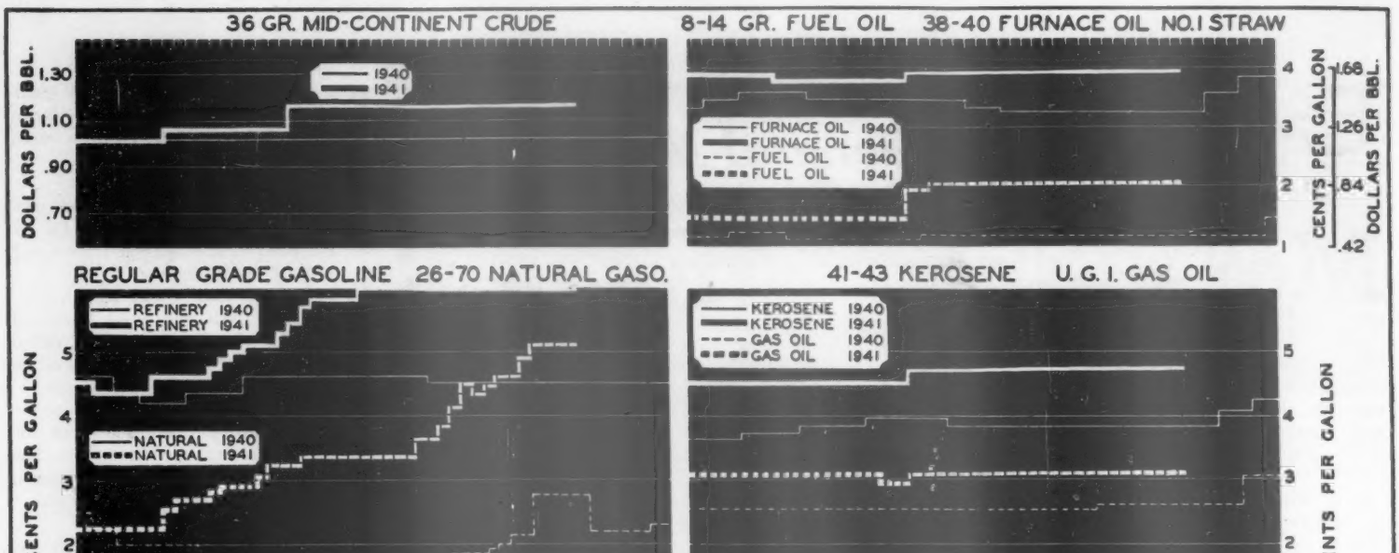
E. J. CARNAHAN, production foreman of General Petroleum Corp., at Santa Fe Springs, Calif., since 1927, has been appointed to a newly created position of production superintendent of the southern division and will maintain headquarters in Vernon, Calif.

PAUL G. BLAZER, president, Ashland Refining Co., Ashland, Ky., has been honored by having a new defense towboat which his company has launched, named for him. The Paul G. Blazer is 145 ft. long, has 31-ft. beam, 8-ft. 6-in. depth, and draws 6 ft., and will ply on the Ohio and Mississippi Rivers. It has a freight capacity of 14,000 tons.

Shifts: GONZALO ACOSTA, engineer, Texas Co., from Sundown, Tex., to Midland, Tex.; HOWARD GRAHAM, superintendent, Tytex Oil Co., from Arp., Tex., to Salem, Ill.; JAMES CLAY, JR., engineer, Stanolind Oil & Gas Co., from Pampa, Tex., to Tulsa; MARK H. O'CONNELL, geologist, Cities Service Oil Co., from Lafayette, La., to Bunkie, La.; W. R. DAMERON, manager, Foster Petroleum Co., from Greenville, Miss., to Dover, Del.; PATRICK A. TRAPP, president, Butte Oil Co., from Butte, Mont., to Chicago; E. E. IVES, superintendent, Cities Service Oil Co., from Bartlesville, Okla., to Oklahoma City, Okla.; E. K. SCHLUNTZ, engineer, Shell Oil Co., Inc., from Tulsa, to Wirt, Okla.; PAUL McNALLE, superintendent, Mac & Stauffer, from Great Bend, Kans., to Big Spring, Tex.

ROLAND J. JOHNSON, superintendent, central division, Plantation Pipe Line Co., supervises operations of the company in Tennessee and Georgia from headquarters at Rome, Ga. During the summer he has been connected with construction of Plantation Pipe Line Co.'s line in New England and Canada. He was formerly an engineer on the staff of Humble Pipe Line Co.

J. M. (JACK) LOFFLAND, of the drilling contracting firm of Loffland Brothers, and GEORGE CALVERT, of Broderick & Calvert, independent producers, returned last week to their Fort Worth, Tex., offices after a successful pheasant hunt near Red Field, S. D. Another party also recently returned and reporting a large bag of pheasants killed near Red Field included D. E. LIAGON, division superintendent for Tide Water-Associated Oil Co. at Houston, Tex.; GURNEY PEOPLES, division manager for Black, Sivalls & Bryson, Inc., Fort Worth; and ARCH ROWAN, of Rowan Drilling Co., Fort Worth.



Representative Mid-Continent Quotations on Crude Oil and Refined Products, Basis Oklahoma (Group 3)

Gasoline Offered a Little More Freely In Group 3 Market, Prices Are Static

By H. STANLEY NORMAN

MARKETS for petroleum products throughout the central portion of the country were static this week. Motor fuel was reported offered a little more freely in the Chicago market but this trend was not apparent in the Mid-Continent refinery sales. Refiners in North Texas, North Louisiana, Arkansas, Oklahoma, Kansas, Missouri and Illinois reported demand brisk at unchanged prices for gasoline and other products.

Shipments of motor fuel from the East Texas area to the Gulf Coast reported 2 weeks ago have dried up spot offerings from that refining district for the present. Previously, there had been limited movement of East Texas gasoline into the northern market in competition with the more centrally located inland plants.

Motor-Fuel Movement Down

Movement of motor fuel from Mid-Continent refineries has tapered off slightly from the high rate prevailing in the midsummer months but shipments continue to exceed expectations of manufacturers. In fact, some of the operators are having difficulty in maintaining their refinery stocks at a minimum of 10 days' requirements which are considered no more than enough to guard against unforeseeable interruptions in production schedules.

Lubricating oils, particularly neutrals and natural gasoline are probably the strongest products in the Mid-Continent refinery market. Orders for lubricating oils of certain qualities have been in excess of productive capacity for several months and refiners have been unable to make up any of the deficiency in stocks which came about through greater consumption in defense industries.

Natural-gasoline manufacturers are keeping a tight rein on stocks in the Mid-Continent district. Orders exceed current production plus inventories and, consequently, manufacturers are prorating distribution, using shipments in 1940 as a basis with adjustments for increases disclosed by the first 9 months of this year. At the current price for 26-lb. material of 5.125 cents per gallon in the Group 3 territory for northern shipment, natural gasoline is nearly 3 cents higher this year than at a comparable period in 1940. Since the first of August, when 26-lb. natural sold in the Group 3 tank-car market at 3.25 cents, the advance to the present figure has been almost a weekly event at increments of 0.125 cent per gallon.

The call for kerosene, tractor fuel and distillate burning oils is gaining momentum, Mid-Continent refiners report, but a majority of distributors are still working from stocks held over from the end of last winter plus material accumulated during the season of low consumption. Operation from stocks extends down through the channels of distribution to the consumer.

Refined Oil Market Barometer

Demand for refinery gasoline is exceeding seasonal expectations, although the rate of deliveries from Mid-Continent plants to northern customers has tapered off slightly during the week. Calls for natural gasoline in the Group 3 territory for northern shipment is running considerably ahead of supplies, prolonging the involuntary system of proration invoked by manufacturers in an effort to spread available supplies among as many customers as possible.

MID-CONTINENT: Calls for light fuel oils are increasing.

GULF COAST: Transportation situation easier. Bunker prices higher.

CALIFORNIA: Fuel oil strong, gasoline unchanged, diesel soft.

PENNSYLVANIA: Neutral-oil supplies growing tighter. Other products strong.

CHICAGO: Tone of gasoline market slightly softer.

Fuel Users Draw on Stocks

Most home owners filled their stock tanks during the summer or early fall, realizing that the fuel-oil market would stiffen with the advent of cold weather. The fall and early-winter season has been mild in most parts of the Midwest consuming territory, minimizing the calls on distributors. Mid-Continent refiners are not particularly concerned over dull aspects of the distillate-fuel market. They are willing to continue storing products in the light-fuel range, feeling that the market will advance promptly when colder weather stimulates inquiries.

Refiners are watching the crude-oil market almost as closely as producers. Producers are continuing their efforts to convince price administration authorities in Washington, D. C., that higher postings are justified on a basis of rising costs. Rumors are current that OPA is sympathetic to claims that costs justify higher crude prices but there is no indication when purchasers who have applications for permission to advance postings pending with OPA will receive the necessary approval.

An increase of 0.5 cent per gallon in the tank-wagon price of gasoline in Standard Oil Co. of Kentucky territory has been authorized by the Office of Price Administration on showing of the company that costs had increased by approximately that amount. The action may have significance in other applications pending for authority to advance prices in the industry, if the showing of cost rises is equally convincing.

Eastern Market Easily Resists More Liberal Product Supplies

By J. P. O'DONNELL

NEW YORK, Nov. 4.—The effect of the return of less than 20 per cent of the tanker tonnage turned over to the British shuttle service has been easily resisted by the East Coast market. This resistance is due to the fact that the market is actually stronger than current prices indicate and also to the fact that the number of tankers returned so far is still insufficient to offset the higher-cost forms of transportation to which the industry was forced to resort to offset the prospects of a supply shortage along the Atlantic Coast. An additional factor is that the tankers have been returned to Western Hemisphere trade and therefore not all will necessarily be used in the Gulf-North Atlantic service.

The effect of the return of 15 tankers in October and 25 more in November will undoubtedly obviate any supply shortage if the bulk of the substitute transportation methods are continued. However, with the latter still in effect, products transported at a high cost will continue to be a factor in the market. This factor will be offset to a large extent by the easier demand situation but, it is believed, not sufficiently to weaken the market unless demand is considerably less than anticipated.

One of the first places that a market weakness would appear would be in the retail-gasoline market since the season of heavy consumption is past and stocks not only increased on the East Coast during October but at the end of the month were somewhat higher than they were at the corresponding time a year ago. No reports of retail price disturbances have been heard and, if the action of metropolitan New York station operators in shortening hours and raising wages of attendants, thus lifting their costs, becomes general, it is quite possible that there will be no disturbance. Acting against this, however, is the somewhat higher margin on which operators are working, a condition which has frequently invited price disturbances.

Six hundred members of the Gasoline Station Council of Metropolitan New York met last week and voted for continuation of the 7 p.m. to 7 a.m. curfew. In order to absorb men thrown out of work by the night closing, operators agreed to shorten hours from 54 to 48 hours per week and at the same time to increase wages $2 to $27 per week. This action will, of course, increase costs and at the same time serve as a brake on price cutting.

While the effects of the tanker return have been imperceptible, there is no assurance that the stability it has indicated for the supply situation will continue indefinitely. In an address before the American Trucking Association convention in New York last week, Allen H. Hand, assistant director of transportation in the Office of Petroleum Coordinator, declared that the East Coast was not yet assured of freedom from a fuel shortage. He pointed out that if the petroleum-supply situation of the British should change, it might be necessary to restore consumption restrictions in this country. At the same time, Mr. Hand urged that every available means of transportation be continued until adequate reserves have been built up.

The process of building up reserves, particularly of refined products, was pursued very successfully in October as the following tabulation of U. S. Bureau of Mines reports reveals (figures in thousands of barrels):

Week ended—	Crude oil	Refined products	All oils	Volume increase
September 27	13,160	61,928	75,088	
October 4	13,944	62,569	76,513	1,425
October 11	14,015	62,797	76,812	299
October 18	13,825	65,545	79,370	2,558
October 25	13,404	66,340	79,744	374
Gain	244	4,412	4,656	4,656

The October increase followed a smaller one of 1,954,000 bbl. from September 6 to September 27 so that in the 7 weeks a total of 6,610,000 bbl. has been added to East Coast stocks. While this surplus will not be sufficient to meet heavier winter demands and the usual draft on storage will come with cold weather, there is every indication that sufficient supplies will be made available.

Residual-fuel-oil stocks continue low but industry statisticians have expressed the belief that supplies will be adequate to meet demands. No sudden and sharp increase in demand for residual fuel oil is expected such as that which normally occurs in heating oil with the advent of cold weather and with a continuation of supplies apparently assured, no difficulty is expected in meeting residual-fuel demands. A considerably different situation applies to lubricating oils, however, and there is marked concern felt in this quarter. Lubricating-oil demand continues strong and inventories continue to decline.

Lubricating-oil stocks for the country as a whole dropped from 8,809,000 bbl. on January 31 to 7,206,000 bbl. on August 31, a drop of 1,603,000 bbl. or close to 20 per cent. This general condition is emphasized in high-grade lubricating oils such as Pennsylvania neutrals. Stocks of the latter had declined to 96,669 bbl. on September 30, the lowest point on record. The reduction from the end of August total was 13,815 bbl. or about 12.5 per cent. In both a price and demand situation, Pennsylvania neutral is in the strongest position that has obtained in years. It is one of the tightest of all petroleum products and in view of the fact that the Government is said to be viewing priority ratings for some of those products it is entirely possible that Pennsylvania neutral may be one of the products, the use of which may be limited by OPM.

Coastal Refiners Pressed To Load Tankers Now Arriving

HOUSTON, Tex., Nov. 3.—The Gulf Coast refinery market appears to be doing an about face as a result of the reversal of the transportation situation. In recent months Gulf Coast refiners have been dealing with a shortage of tankers and combating difficulties of moving supplies to consumers.

Return of American tankers to the East Coast trade has freed the transportation situation materially. Refiners are now complaining that tankers are arriving ahead of schedule and causing inconvenience because production schedules are in some cases geared to the time specified for loading cargoes. Stocks on the Gulf Coast have been depleted to a point that most cargoes are sold on a basis of production between the time of sale and the specified loading date. Early arrival of boats keeps refiners under constant pressure to meet commitments as rapidly as possible. Several of the major companies are reported to be putting out feelers to independent refiners for gasoline contracts for next year. No definite offers as to quantities or price have been broached, it is understood, but it is indicated these companies will want increased supplies during the coming year. In view of the general scarcity of available gasoline at this time and the prospects of increasing lend-lease demand, most independent refiners

(Continued on Next Page)

A.P.I. Weekly Refinery Statistics

FIGURES FOR THE WEEK ENDED NOVEMBER 1, ARE UNAVAILABLE OWING TO NEW YORK ELECTION

Stocks of Crude Oil in the United States

(BUREAU OF MINES ESTIMATES)

Week ended October 25, 1941	242,261,000 barrels
Week ended October 18, 1941	243,605,000 barrels
Week ended October 26, 1940	262,746,000 barrels

Figures do not include stocks of heavy, unrefinable California crude.

RETAIL OIL MARKETS...

Tank-wagon and filling-station prices on gasoline and kerosene furnished by larger marketing firms

Prices as of November 4, 1941

Taxes

The gasoline quotations given in the following tables include the 1½-cent federal tax, as well as state, county, and city taxes. The gasoline is the regular or standard grade. In most areas lower grades and a premium grade also are available.

Standard Oil Co. (Indiana)

	Gasoline Tank wag.	Dir.	Inc. tax	Kero. tank wag.
Chicago, Ill.	16.1	14.1	4.5	10.3
Decatur	15.4	13.4	4.5	9.5
Joliet	16.4	14.1	4.5	10.3
Peoria	16.2	13.7	4.5	10.1
Quincy	13.4	12.4	4.5	10.0
Davenport, Ia.	16.2	14.7	4.5	10.1
Des Moines	15.9	11.9	4.5	9.8
Mason City	16.2	14.7	4.5	10.1
Duluth, Minn.	17.7	16.2	5.5	10.6
Mankato	17.4	15.9	5.5	10.3
Minneapolis	17.4	15.9	5.5	10.3
La Crosse, Wis.	17.4	15.9	5.5	10.3
Green Bay	17.7	16.2	5.5	10.6
Milwaukee	17.6	16.1	5.5	10.5
Detroit, Mich.	15.9	14.4	4.5	9.6
Grand Rapids	15.9	14.4	4.5	9.6
Saginaw	15.9	14.4	4.5	9.6
Evansville, Ind.	16.9	15.4	5.5	9.6
Indianapolis	17.1	15.2	5.5	9.8
South Bend	17.5	16.0	5.5	10.2
Fargo, N. D.	18.4	16.9	5.5	11.3
Huron, S. D.	17.8	16.3	5.5	10.7
Kansas City, Mo.*	14.9	13.4	4.5	9.4
St. Louis*	14.8	13.3	4.5	9.8
St. Joseph	15.7	14.2	4.5	9.6
Wichita, Kans.	14.8	12.7	4.5	8.0

*State tax 2 cents, 1-cent city tax, and 1½-cent federal tax.

Exclusive of state general sales taxes.

Discounts to commercial consumers. On purchases per month off tank-wagon prices: 1,000 gal. or more, 1.5 cents off, minimum delivery 25 gal.

Stanolex Fuel Oil in Chicago

Effective Sept. 18, 1941, f.o.b. Chicago, tank-wagon prices: Standard heater oil, 1-99 gal., 9.0 cents; 100-149 gal., 8.0 cents; 150 gal. and over, 7.5 cents. Stanolex fuel oil No. 1, 1-99 gal., 8.5 cents; 100-149 gal., 7.5 cents; 150-399 gal., 7.5 cents; 400 gal. and over, 7.0 cents. Stanolex furnace oil, 1-99 gal., 8.5 cents; 100-149 gal., 7.5 cents; 150-399 gal., 7.5 cents; 400 gal. and over 7.0 cents. Stanolex fuel oil A, 1-99 gal., 8.0 cents; 100-399 gal., 7.0 cents; 400-749 gal., 6.0 cents, 750 gal. and over, 5.25 cents. Stanolex fuel oil B, 1-99 gal., 8.0 cents; 100-399 gal., 7.0 cents; 400-749 gal., 6.0 cents; 750 gal. and over 5.25 cents. Stanolex Bunker C fuel oil, 1-399 gal., 6.5 cents; 400-999 gal., 5.5 cents; 1,000 gal and over, 4.5 cents.

Ohio

STANDARD OIL CO. OF OHIO

	Gasoline Cons'r tank wag.	Dividend dir.	Inc. tax	Kero. tank wag.
Ohio points	16.0	15.0	5.5	*9.0

*Includes state tax of 1 cent.

Southern District

STANDARD OIL CO. (KENTUCKY)

	Gasoline Cons'r tank wag.	Net dir.	Inc. tax	Kero. tank wag.
Atlanta, Ga.	18.00	18.00	7.5	10.0
Augusta	18.00	18.00	7.5	9.5
Macon	18.00	18.00	7.5	10.0
Savannah	17.00	17.00	7.5	9.0
Birmingham	18.50	18.50	8.5	8.0
Mobile	18.50	18.50	9.5	8.5
Montgomery	19.50	19.50	9.5	10.0
Jackson, Miss.	17.50	17.50	7.5	9.0
Vicksburg	17.00	17.00	7.5	8.5
Jacksonville, Fla.	18.00	18.00	8.5	8.0
Miami	18.00	18.00	8.5	8.0
Pensacola	18.50	18.50	9.5	8.0
Tampa	18.00	18.00	8.5	8.0
Lexington, Ky.	17.00	17.00	6.5	9.0
Covington	16.0	16.0	6.5	9.0
Louisville	16.50	16.50	6.5	8.5
Paducah	16.50	16.50	6.5	8.5

Price basis to tank-wagon consumers, effective January 4, 1937, 3 cents per gallon below tank-wagon price.

Montgomery, Ala., has a county tax of 1 cent per gallon on gasoline, in addition to state tax, and 1 cent per gallon on kerosene. Mobile, Ala., has a city gasoline tax of 2 cents per gallon; Birmingham, Ala., has a city gasoline tax of 1 cent per gallon; Pensacola, Fla., has a city gasoline tax of 1 cent. All are included in the table.

Atlantic Coast District

STANDARD OIL CO. OF NEW JERSEY

	Gasoline Cons'r tank wag.	Dir. tank wag.	Inc. tax	Kero. tank wag.
Atlantic City	13.5	14.0	4.5	7.9
Newark	13.5	14.0	4.5	7.9
Annapolis	14.85	15.35	5.5	9.7
Baltimore	14.25	14.75	5.5	8.7
Cumberland	15.65	16.15	5.5	10.2
Washington, D. C.	12.50	13.00	3.5	9.2
Danville, Va.	16.95	17.45	6.5	10.45
Norfolk	15.75	16.25	6.5	10.2
Petersburg	16.05	16.55	6.5	11.2
Richmond	16.05	16.55	6.5	11.2
Roanoke	17.25	17.75	6.5	10.7
Charles'n, W. Va.	17.55	18.05	6.5	11.5
Parkersburg	16.85	17.35	6.5	11.5
Wheeling	16.85	17.35	6.5	11.8
Charlotte, N. C.	18.40	18.90	7.5	9.5
Hickory	18.95	19.45	7.5	10.5
Mount Airy	18.80	19.30	7.0	9.7
Raleigh	18.15	18.65	7.0	10.5
Salisbury	18.45	18.95	7.5	10.9
Charleston, S. C.	17.25	17.75	7.5	(*)
Columbia	18.10	18.60	7.5	(*)
Spartanburg	18.80	19.30	7.5	(*)

Price basis to Essolene undivided dealers: Dealer tank-wagon price less 0.5 cent per gallon. Price basis to commercial consumers, effective March 8, 1937, in Maryland, District of Columbia, and in Arlington and Fairfax counties in Virginia and March 12 in New Jersey: To contract accounts purchasing at least one full compartment at a time by hose connections, on yearly purchases: From 2,500 to 100,000 gal., consumer tank-wagon price at time and place of delivery: 100,000 gal. per year, consumer tank-car price plus 0.5 cent per gallon. Consumer tank-wagon price generally will be equivalent to dealer tank-wagon price less 0.5 cent per gallon.

Effective January 16, 1939, in North Carolina the commercial consumer schedule became as follows: Single deliveries of 50 gal. or more, consumer tank-wagon price. Single deliveries of less than 50 gal., 4 cents per gallon over consumer tank-wagon price. Generally the posted consumer tank-wagon price will be equivalent to the dealer price, less 0.5 cent per gallon. The above policy also applies in South Carolina, effective January 23, 1939.

*Kerosene business of the company at these points now exclusively handled by dealers.

Pennsylvania and Delaware

ATLANTIC REFINING CO.

	Gasoline Cons'r tank car	Dir. tank wag.	Inc. tax	Kero. tank wag.
Philadelphia, Pa.	14.0	15.0	5.5	10.15
Pittsburgh	14.5	15.5	5.5	10.5
Allentown	14.5	15.5	5.5	10.5
Erie	14.5	15.5	5.5	10.5
Scranton	14.5	15.5	5.5	10.5
Altoona	14.5	15.5	5.5	10.5
Dover, Del.		15.5	5.5	10.5
Wilmington		15.0	5.5	10.0

Price basis to undivided dealers, dealer tank-wagon price less 0.5 cent per gallon.

Discount on kerosene, 2 cents per gallon off tank-wagon price on tank-wagon deliveries of 25 gal. or more at one time.

Pacific Coast Territory

STANDARD OIL CO. OF CALIFORNIA

	Gasoline Tank truck*	Serv. sta.	Inc. tax	Kero. tank wag.
San Francisco	14.5	18.5	4.5	11.5
Los Angeles	14.0	18.0	4.5	10.0
Fresno, Calif.	15.5	19.5	4.5	12.5
Phoenix, Ariz.	18.5	22.5	6.5	12.5
Reno, Nev.	17.5	21.5	5.5	13.5
Portland, Ore.	17.0	21.0	6.5	13.5
Seattle, Wash.	17.0	21.0	6.5	13.5
Spokane	19.0	23.0	6.5	16.5
Tacoma	17.0	21.0	6.5	13.5

*Posted net tank-truck prices (including tax).

Resale and commercial discounts, effective October 1, 1941: Tank-car deliveries 0.25 cent a gallon off posted net tank truck. Commercial: Retail deliveries, and/or tank-truck deliveries of less than 40 gal., 4 cents per gallon above posted net tank-truck price for Standard Aviation, Standard's Supreme, and Standard Gasoline, and 3 cents per gallon above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gal. to marine trade only, which are billed at posted net tank-truck price.

Rocky Mountain District

CONTINENTAL OIL CO.

	Gasoline Tank wag.	Inc. tax	Kero. tank wag.
Denver, Colo	14.5	5.5	11.0
Grand Junction	18.0	5.5	12.5
Pueblo	14.5	5.5	9.5
Casper, Wyo.	17.0	5.5	12.0
Cheyenne	16.0	5.5	11.5
Billings, Mont.	18.0	6.5	12.5
Butte	17.0	6.5	13.5
Great Falls	17.0	6.5	12.5
Helena	17.0	6.5	13.0
Salt Lake, Utah	18.5	6.5	14.5
Boise, Idaho	†20.1	6.5	16.5
Twin Falls	†21.1	6.5	17.0
Albuquerque, N. M.	*17.5	7.0	10.0
Roswell	*15.5	7.0	8.5
Santa Fe	‡18.0	7.5	10.0

*Includes city tax of 0.5 cent. †Includes toll-bridge tax of 1 mill. ‡Includes city tax of 1 cent.

Tank wagon represents price to consumers. Dealer represents price to dealers. If no dealer price is quoted, the tank-wagon price applies to all classes of trade.

Oklahoma and Arkansas

CONTINENTAL OIL CO.

	Gasoline Tank wag.	Incl. tax	Kero. tank wag.
Texarkana, Ark.	14.0	5.5	6.0
Fort Smith	15.5	7.0	6.5
Little Rock	17.25	8.0	8.0
Muskogee, Okla.	15.0	7.0	8.0
Oklahoma City	15.0	7.0	8.0
Tulsa	15.0	7.0	8.0

Tank wagon represents price to consumers. If no dealer price is quoted, the tank-wagon price applies to all classes of trade.

Central South District

STANDARD OIL CO. OF LOUISIANA

	Gasoline Cons'r tank wag.	Dir. tank wag.	Incl. tax	Kero. tank wag.
New Orleans, La.	17.25	17.50	8.5	‡10.0
Baton Rouge	17.25	17.50	8.5	‡10.5
Alexandria	17.25	17.50	8.5	‡10.5
Lafayette	17.50	18.00	8.5	‡10.0
Lake Charles	17.50	18.00	8.5	‡12.0
Shreveport	17.00	17.0	8.5	‡9.0
Knoxville, Tenn.	20.00	20.50	8.5	12.5
Memphis	17.25	17.75	8.5	10.5
Chattanooga	19.00	19.5	8.5	11.0
Nashville	19.00	19.5	8.5	10.0
Bristol	18.25	18.75	8.5	12.0

Esso at dealer price less 0.5 cent per gallon to undivided dealers.

‡Includes 1-cent state tax.

Price basis to commercial consumers throughout Louisiana, Arkansas, and Tennessee: On single deliveries of 50 gal or more at a time—posted consumer tank-wagon price. On single deliveries of less than 50 gal. at a time—posted consumer tank-wagon price plus 4 cents per gallon. Generally, the posted consumer tank-wagon price is the same as the posted dealer tank-wagon price, less 0.5 cent per gallon.

New York and New England

SOCONY-VACUUM OIL CO., INC.

	Gasoline Comm. tank wag.	Dir.* tank wag.	Inc. tax	Kero. tank wag.
Albany	14.2	14.7	5.5	7.7
Met. New York	14.4	14.9	5.5	8.0
Buffalo	14.5	15.0	5.5	8.3
Rochester	15.1	15.6	5.5	8.8
Syracuse	14.8	15.3	5.5	8.7
Portland, Me.	14.6	15.1	5.5	8.1
Manchester, N. H.	15.6	16.1	5.5	9.0
Burlington, Vt.	15.2	15.7	5.5	8.3
Boston, Mass	13.2	13.7	4.5	8.0
Worcester	13.8	14.3	4.5	8.1
Hartford, Conn.	13.9	14.4	4.5	7.6
New Haven	13.3	13.8	4.5	6.9
Providence, R. I.	13.3	13.8	4.5	7.8

*Undivided.

Effective August 8, 1940, the company changed its commercial consumer policy in New York and New England to the following:

Full compartment deliveries: Accounts buying less than 20,000 gal. annually, 0.5 cent above the commercial-consumer price; acccunts buying from 20,000 to 120,000 gal. annually, commercial-consumer price; accounts buying 120,000 gal. annually and above, 0.25 cent off consumer price. Split compartment deliveries: Delivery of less than a full compartment, 250 gal., commercial-consumer price plus 1 cent. Steel-barrel deliveries: Commercial price plus 3 cents.

Nebraska

STANDARD OIL CO. OF NEBRASKA

	Gasoline Tank wag.	Dir.	Incl. tax	Kero. tank wag.
Omaha	17.9	15.4	6.5	9.5
McCook	18.5	15.9	6.5	9.5
Norfolk	18.4	16.9	6.5	10.2
North Platte	18.8	16.4	6.5	10.7
Scottsbluff	18.9	16.0	6.5	9.5

Discounts to commercial consumers for tank-wagon deliveries covered only by standard commercial consumers contract, effective January 1, 1935.

Texas

	Gasoline Tank wag.	Serv. sta.	Incl. tax	Kero. tank wag.
Dallas, Tex.	14.0	17.0	5.5	7.0
Fort Worth	14.0	17.0	5.5	7.0
Houston	14.0	18.0	5.5	8.0
San Antonio	14.0	18.0	5.5	7.0

Naphtha

STANDARD OIL CO. (INDIANA)

	Tank wagon*
Oleum spirits	16.2
V.M.&P. naphtha	16.5
Cleaners' naphtha	15.5
Stanisol	15.5

*Prices include 3-cent Illinois tax but not 1-cent federal tax nor 2 per cent retail occupational tax.

Prices f.o.b. Chicago. Each price subject to discount of 1 cent per gallon for 150-gal. lots if covered by contract.

Canada*

3-Star Imperial Gasoline

IMPERIAL OIL, LTD.

	Gasoline Tank wag.	Incl. tax	Kero. tank wag.
Halifax, N. S.	29.5	13.0	19.0
St. John, N. B.	29.5	13.0	19.0
Montreal, Que.	28.0	11.0	17.5
Toronto, Ont.	28.5	11.0	18.0
Hamilton, Ont.	28.5	11.0	18.0
Winnipeg, Man.	30.5	10.0	22.5
Brandon, Man.	31.0	10.0	23.0
Regina, Sask.	28.0	10.0	20.0
Saskatoon, Sask	30.8	10.0	22.8
Edmonton, Alta.	28.9	10.0	20.9
Calgary, Alta.	26.0	10.0	18.0
Vancouver, B. C.	25.0	10.0	24.0

*Imperial gallon used in Canada.

Divided dealers pay tank-wagon prices. Discount to undivided dealers, 1 cent below tank-wagon price. In Maritime Provinces both divided and undivided dealers pay tank-wagon price.

Gulf Coast Markets

(Continued from Preceding Page)

are inclined not to want to tie up any great amount of their future production on such contracts.

Due to the fact there is very little material of any description open for sale, the Gulf Coast refinery markets continue practically at a standstill; the only activity is in movement of supplies already contracted. No new trading in any product was reported during the week with sellers maintaining only nominal quotations as previously listed.

The only evidence of uncertainty as to strength lies in residual fuels, of which ample supplies seem available. Sellers generally are quoting 90 cents for cargo lots of Bunker C grade, but buyers advise they still can get supplies as low as 85 cents. There are still some unsold stocks of No. 2 fuel, but sources of this supply are capable of and are holding for later demand which is expected to bring higher prices.

PRICES OF REFINED PRODUCTS...

All quotations f.o.b. plant in cars for interstate or export movement except as otherwise noted

Prices as of November 4, 1941

(Most prices in cents per gallon)

The quotations are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils. Octane ratings in Middle West, Mid-Continent, and Southwest are based on A.S.T.M. method of testing.

Refinery Gasoline

OKLAHOMA (Group 3)—

U. S. Motor grades:		
72-74 octane (regular)	.06	.0625
63-66 octane	.05625	.05875
60 octane and below	.0525	.055
60-62 400 grades:		
72-74 octane (regular)	.06	.0625
63-66 octane	.05625	.05875
60 octane and below	.0525	.055

NORTH TEXAS—

U. S. Motor grades:		
72-74 octane (regular)	.05875	.06125
63-66 octane	.0550	.06
60 octane and below	.05125	.05375
60-62 400	.05	.06

NORTH LOUISIANA (Ark. and N. La. delivery)—

U. S. Motor grades:		
72-74 octane (regular)	.05875	.06125
63-66 octane	.0550	.05875
60 octane and below	.05	.06

ARKANSAS (Ark. and N. La. del.)—

U. S. Motor grades:		
72-74 octane (regular)	.05875	.06125
60 octane and below	.05	.05375

CHICAGO (Based on Group 3)—

U. S. Motor grades:		
72-74 octane (regular)	.06	.0625
63-66 octane	.05625	.05875
60 octane and below	.0525	.055
60-62 400 grades:		
72-74 octane (regular)	.06	.0625
63-66 octane	.05625	.05875
60 octane and below	.0525	.055

PENNSYLVANIA (inland refineries)—

74-76 octane (regular)	.0750	.0775
80 octane (1939 Research)		.0800

CALIFORNIA (domestic movement)—

58-60 400, 65 oct. and higher	.065	.0725
54-58 U. S. Motor	.0575	.0625

EAST COAST (domestic)—

U. S. Motor (minimum 72 octane):		
New York (Bayonne)*	.08	.085
Philadelphia	.08	.0825
Boston	.085	.09
Baltimore	.08	.0825
Charleston, S. C.	.0725	.0775

*All grades of gasoline ⅛ to ¼ cent less for barge shipments. New York Harbor prices are for New York and New England delivery. Prices for New Jersey delivery ¼ cent lower.

GULF COAST (domestic)—

U. S. Motor grades:		
80 plus (research)	.06625	.0675
72-74 octane (leaded)	.0625	.06375
70-72 octane (unleaded)	.0625	.0650
68-70 octane (unleaded)	.0625	.0650

Natural Gasoline

OKLAHOMA (Group 3)—

Grade 26-70		.05125
Grade 18-55	.06125	.0625

NORTH TEXAS—

Grade 26-70		.0475
Grade 18-55	.05625	.0575

CALIFORNIA—

75-85 375-390	.045	.05

NORTH LOUISIANA (Ark. and N. La. delivery)—

Grade 26-70		.0475

Tractor Fuel

OKLAHOMA (Group 3)—

40-42 gr., 315-325 l.b.p. 110-flash, 540-550 e.p.	.0375	.03875
41-43 gr., 300-320 l.b.p. 110-125 flash, 500-520 e.p.	.03875	.04
46-48 gr., 210-230 l.b.p. 480 max., e.p.	.04125	.0425

Kerosene

(All kerosene water white)

OKLAHOMA (Group 3)—

42-44	.0450	.0475
41-43	.04375	.04625

NORTH TEXAS—

41-43	.0425	.04625

NORTH LOUISIANA (Ark. and N. La. delivery)—

41-43	.04375	.04625

ARKANSAS (Ark. and N. La. del.)—

41-43	.04375	.04625

PENNSYLVANIA (inland refineries)—

46	.0625	.06625
45	.0625	.065

CHICAGO (Based on Group 3)—

42-44	.0450	.0475
41-43	.04375	.04625

CALIFORNIA (Pac. Coast market)—

38-40 high-burning test	.045	.055

NEW YORK (Bayonne, N. J.)—

41-43		.055

GULF COAST (domestic)*—

41-43	.04	.04125

*Barge price ⅛ cent lower.

Furnace Oil

OKLAHOMA (Group 3)—

Range oil	.04	.0425
No. 1 white (38-42)	.03875	.04125
No. 2 straw (32-36)	.03625	.03875
No. 3 zero to 10 (28-32)	.035	.0375

NORTH TEXAS—

No. 1 white (38-42)	.03825	.04125

NORTH LOUISIANA (Ark. and N. La. delivery)—

No. 2 (32-36)	.0325	.035

ARKANSAS (Ark. and N. La. del.)—

No. 2, 32-36	.0325	.035

CHICAGO (Based on Group 3)—

Range oil	.04	.0425
No. 1 white (38-42)	.03875	.04125
No. 2 straw (32-36)	.03625	.03875
No. 3 zero to 10 (28-32)	.035	.0375

NEW YORK (Bayonne, N. J.)—

*No. 1		.055
*No. 2	.051	.0525
*No. 3	.051	.0525

*Barge deliveries ⅛ to ¼ cent under above tank-car price.

Gas Oil and Fuel Oil

(Gas oil per gal., fuel oil per bbl.)

OKLAHOMA (Group 3)—

No. 5, low pour point (18-22)	.85	.90
No. 6, 15 and above (10-16)	.85	.90

NORTH TEXAS—

No. 5, low pour point (18-22)	.80	.85
No. 6, 15 and above (10-16)	.80	.85

NORTH LOUISIANA (Ark. and N. La. delivery)—

10-14 fuel oil, industrial	.80	.85

CHICAGO (Based on Group 3)—

No. 5, low pour point (18-22)	.85	.90
No. 5, 15 and above (18-22)	.85	.90
No. 6, low pour point (10-16)	.85	.90
No. 6, 15 and above (10-16)	.85	.90

PENNSYLVANIA (inland refineries)—

36-40	.05875	.0625

CALIFORNIA—

Los Angeles:		
30-40 gas oil, per bbl.	1.10	1.25
24 plus diesel, per bbl.	1.10	1.25
24 plus diesel (bunkers)	1.20	1.35
12-16 (bunkers at tidewater)	.75	.85
10-16 (cargo lots)	.75	.85
12-17 (tank cars)	.65	.75
10-17 (high sulfur)	.55	.65
San Joaquin Valley:		
10-18 (tank cars)	.70	.85
24 plus diesel, per bbl.	1.10	1.25
San Francisco:		
24 plus diesel, per bbl.	1.35	1.40
24 plus diesel (bunkers)	1.40	1.50
10-16 (bunkers)	.80	.85

GULF COAST—

No. 2 fuel		.04
43-47 diesel		.04125
48-52 diesel	.04125	.0425
53-57 diesel		.0425
58-and-above diesel	.0425	.04375
Diesel bunkers		1.45
Bunker C (bulk cargoes)		.90
Bunker C (bunkers)	.875	.90

NEW YORK (Bayonne, N. J.)—

27 plus, gas oil		.050
28-30 diesel (lighterage 6¼c per bbl.)		2.15
28-30 diesel (tank cars)		.05
Bunker C (to ocean-going ships in N. Y. Harbor)	1.35	1.45
Industrial fuel (tank cars)		.044

Lighterage charge 5c bbl. additional.

Bright and Steam Refined

OKLAHOMA (Group 3)—

200-210 D, 10-25		.27
150-160 D, 0-10		.23
150-160 D, 10-25		.225
120-125 D, 0-10		.225
120-125 D, 10-25		.22
Steam refined:		
600 dark green (untreated)		.145

PENNSYLVANIA—

Bright Stocks (Pennsylvania Grade No. 8 color, 140-150 at 210, 545-550 flash):		
10 pour point		.305
15 pour point		.295
25 pour point	.25	.28
Steam refined:		
600	.15	.16
650	.155	.165
600 flash	.16	.18
630 flash	.17	.185

Neutral Oil

(Vis. at 100° F. except Pennsylvania and color N.G.A.)

OKLAHOMA (Group 3)—

0-10 pour point:		
150-3		.145
180-3		.15
200-3		.15
250-3		.165
280-3		.175
280-4		.17
300-3		.185
350-3½		.19
400-3½		.20
500-3½		.205
600-3½		.21
100-2½ paraffin oil 10-25		.0825
10-25 pour point:		
200-3		.145
250-3		.16
280-3		.17
280-4		.165

CALIFORNIA (moving to dom. mkt.)—

Pale oils:		
200-2½-3	.07	.0775
300-2½-3	.07	.0775
400-3-4	.0725	.08
450-3-4	.0725	.08
550-3-4	.0875	.1075
600-3-4	.0875	.11
Red oils:		
200-4-5	.07	.0775
300-5-6	.0725	.08
350-5-6	.09	.11
400-5-6	.09	.11
450-5-6	.09	.1125
500-5-6	.0925	.1125
600-5-6½	.0925	.1125
700-6½ plus	.0925	.1125
750-6½ plus	.0925	.1125
900-6½ plus	.0925	.1125

GULF COAST—

Pale oils:		
100-3	.0625	.0650
200-3	.0850	.0875
300-3	.09	.0925
500-3½	.0975	.10
750-3½	.10	.1025
1,200-3½	.1025	.10375
2,000-4	.1050	.1075
3,000-4	.1225	.1250

PENNSYLVANIA—

150 vis. at 70° F., 3 color, 400-405 flash:		
Zero pour point		.385
10 pour point		.375
15 pour point		.365
25 pour point		.31
200 vis., at 70° F., 3 color:		
Zero pour point		.405
10 pour point		.395
15 pour point		.385
25 pour point		.33

Wax and Petrolatum

(Prices per pound)

OKLAHOMA (Group 3)—

124-126 (A.m.p.) w.c. scale	.06	.06125

PENNSYLVANIA (inland refineries)—

122-124 (A.m.p.) w.c. scale		.0625
124-126 (A.m.p.) w.c. scale		.0625

NEW YORK—

Wax in bags fully refined:		
125-127 (A.m.p.) wax	.0560	.0640
128-130 (A.m.p.) wax	.0560	.0660
130-132 (A.m.p.) wax		.0585
133-135 (A.m.p.) wax		.0615
135-137 (A.m.p.) wax		.0640
Crude scale:		
124-126 (A.m.p.) w.s.		.0625
124-126 (A.m.p.) y.s.		.0625
Petrolatum in barrels, carload lots:		
Dark green		.02875
Amber	.02875	.03125
Extra amber	.03125	.03375
Lily white	.04875	.05375
Snow white	.05625	.05750
Cream	.04125	.05250

Export Prices

GASOLINE

GULF COAST—

60-62 400	.0550	.0675
61-63 390	.0575	.0650
64-66 375	.0575	.0650

LOS ANGELES—

U. S. Motor grades:		
Above 60 octane	.06	.0625
65-69 octane	.0575	.06
60-65 octane	.0525	.055

KEROSENE

GULF COAST—

41-43 water white	.0375	.04

LOS ANGELES—

41-43 water white	.05	.0525

LUBRICANTS

(Pennsylvania Grade)

NEW YORK (f.o.s. in bbl.)—

Cylinder stocks:		
600 S. R. unfiltered		.265
630 S.R. unfiltered		.27
600 flash, S.R.		.265
650 flash, S.R.		.27
Bright stock:		
Light, 25 pour point	.36	.37

NEUTRAL OIL

200-3 color	.43	.50
150-3 color	.41	.46

PARAFFIN WAX

NEW YORK (prices per bbl.)—

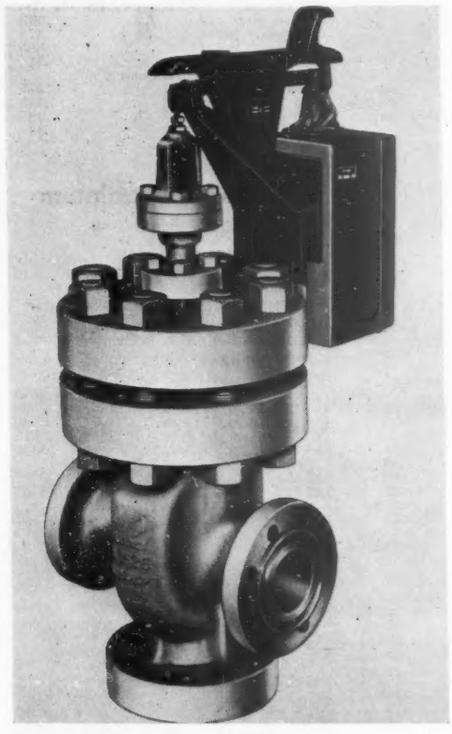
123-125 A.m.p.	.0560	.0625
125-127 A.m.p.	.0560	.0625
128-130 A.m.p.	.0585	.0650
133-135 A.m.p.	.0615	.0700
135-137 A.m.p.	.0640	.0700
Crude scale:		
124-126 w.s.		.0625
124-126 y.s.		.0625

EQUIPMENT PROGRESS...

Manning Power-Control Valve Supplements Spring Valve

The Ashcroft power-control valve for high pressure installation from 1800 to 2500 lb. is announced by the Consolidated Safety Valve division of Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut.

This new power control valve is an automatic relief valve that may be set for a 1 per cent or less differ-



ence between opening and closing pressure; which effects a large saving over the 4 per cent required for the spring-loaded safety valves.

The principle of operation of the Ashcroft power-control valve is very simple. The boiler drum or superheater outlet pressure or steam header pressure actuates a pressure control set at the popping pressure, which operates an electric contact on a difference in pressure of 1 per cent or less. The electric current is transmitted to a solenoid which opens and closes the pilot valve.

When it opens it unbalances the pressure over the main valve disk and it opens and remains open until the pilot valve is closed. The whole cycle of operation is almost instantaneous. The power-control valve opens exactly at the popping pressure and it closes cleanly with an extremely low blow-down. High superheat temperatures have no effect on its action. It may be operated manually from the control station.

The Ashcroft power-control valve is not intended to replace the spring-loaded safety valve, but rather it is a supplementary operating valve, designed to conserve power and increase the efficiency of the steam-generating plant.

A complete new, descriptive catalog fully illustrated with installation drawings, will be furnished to anyone writing to the above company and requesting a copy.

TRADE LITERATURE

BROWN INSTRUMENT CO., Wayne and Roberts Avenues, Philadelphia, Pa. — Catalog 6706-H, giving specifications and operating principles of the numerous types and models of the complete line of Brown thermometers and pressure gages. Such sections as those on application, arrangement, connection, etc., make it a handbook of practical data for the engineer.

WAGNER ELECTRIC CORP., 6389 Plymouth Avenue, St. Louis, Mo.—A 28-page air-brake sales bulletin, Form KU-50, which describes in detail and illustrates the three Wagner air-brake systems—the Wagner Hydrair brake, the Wagner air-hydraulic brake, and the Wagner straight-air brake—and the various air-brake parts manufactured by the company.

ELLIOTT CO., Jeannette, Pa.—Bulletin G-7 on Elliott steam jet ejectors. It contains a very complete discussion of ejectors illustrated with many shop and installation views.

AIR REDUCTION SALES CO., Lincoln Building, New York.—A booklet, "Air Reduction—A Quarter Century of Progress," giving a brief history of the organization and growth of Air Reduction and the various subsidiary companies that make up Air Reduction Co., Inc. The book is profusely illustrated and has been designed to give a quick over-all picture of the products produced by Air Reduction and its subsidiary companies and the use of these products in industry and defense.

PROTECTIVE COATINGS, Inc., 10391 Northlawn, Detroit, Mich.—A booklet, "The Tocol Line," containing complete information about and description of all of the items in the Tocol line of protective coatings, including synthetics, specialties, rubber, etc.

CLIMAX MOLYBDENUM CO., 500 Fifth Avenue, New York.—Revised, loose-leaf sections for "Molybdenum in Steel." During the past few years considerable work has been done on both the metallurgy and practical application of molybdenum steels. As a result, valuable data have accumulated and incorporated in revised and expanded sections and made available to those possessing copies of the original book. The revised sections are Section 1, Introduction; Section 5, Carbon Molybdenum Steels; Section 11, Molybdenum Tool Steels; Section 12, Molybdenum High Speed Steels; General Index, and Physical property charts.

Timken-Detroit Official Honored By Army for Industrial Work

Col. Herbert W. Alden, director of engineering of the Timken-Detroit Axle Co., received the Col. Frank A. Scott Gold Medal for Meritorious Service to Industrial Preparedness, at the twenty-second annual meeting of the Army Ordnance Association in Detroit, Mich., October 9. Colonel Alden, chairman of the S.A.E. Ordnance Automotive Advisory Committee, is an engineer consultant to the Chief of Ordnance, and has a record of service with the Ordnance Department dating back to 1917.

Colonel Alden was one of the founders of the Timken-Detroit Axle Co., in 1909, becoming chief engineer. He was vice president of the company until 1922, chairman of the board, 1922-1940, and is now director of engineering. He has long been vitally interested in ordnance problems. Except for two years since 1920, he has served continuously as chairman of the S.A.E. ordnance advisory committee. Last year he became a member of the S.A.E. national defense committee.

Foxboro Recommends Oxygen Bomb Test for Gasoline

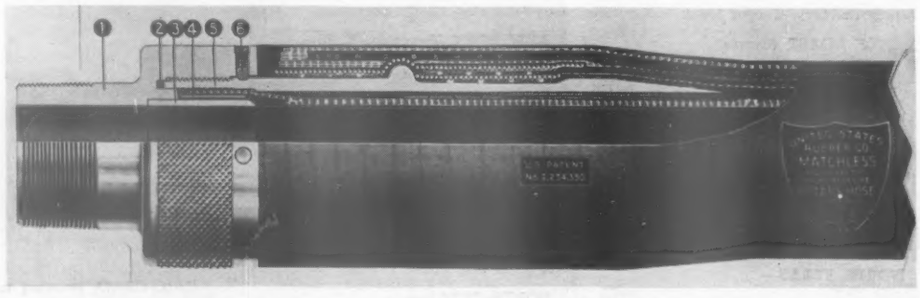
Use of the oxygen bomb test at this time of year for determining the storage life of gasoline is recommended by the Foxboro Co., Foxboro, Mass., manufacturers of the Foxboro Recorder used for oxygen bomb test equipment.

The company states that among samples of the same gasoline, treated or inhibited in different ways, there is usually correlation between the length of induction period in the oxygen bomb and the actual storage life of the gasoline. Among gasolines of widely different origin, the induction period is not as significant as the increase in induction period caused by inhibiting the gasoline.

The Foxboro recorder employed in this service, like all Foxboro instruments, is fully guaranteed and represents the high standards maintained by the company.

U. S. RUBBER REVEALS DETAILS OF ROTARY HOSE COUPLING

United States Rubber Co., New York, has issued a detailed drawing of the built-in coupling on its newest type of rotary hose. The assembly drawing, shown here,



reveals that the coupling, which is used on both U. S. Matchless and Peerless brands is an integral streamlined part of the hose itself, requires no flanges, nozzles, bolts, nuts, clamps or hydraulic nipples, and provides a full hole connection. Through the use of a special type of cap and expansion ring a coupling is provided that is claimed to be leakproof and to actually tighten the seal as the pressure increases. Male threads are provided on both ends of the hose.

This construction, the company said, has been developed to meet increasing demands of the oil producing industry. Frequent, fast changes involve heavier and larger equipment, deeper and deeper drilling and constantly increasing presures. These make necessary the utmost in caution and accomplishment in hose and coupling design. The company states that this streamlined type of built-in coupling represents the answer of their engineers to the problem. It has been tested in both the laboratory and the field, for nearly 2 years, under the most extreme conditions, and is at present operating successfully on many widely varied drilling jobs.

Key to cut-away drawing of built-in coupling on newest type of rotary hose is: (1) coupling cap; (2) end cap seal; (3) expansion ring protector; (4) expansion retaining ring; (5) built-in nipple; (6) coupling cap anchor seal.

Micromax Recorder Indicates Clearly pH of Dehydrator Water

By glancing at the bold indicating scale of a Micromax recorder and noting the position of its black pointer, refinery operators can now "see" the pH of

dehydrator water and can regulate the flow of ammonia or caustic for correct neutralization in the tower. Or by examining the red-ink chart record drawn by the recorder, they can see the trend of pH during the past hour, day or week.

They can have this information at any time, for an L.&N. glass electrode assembly constantly detects the pH of a continuously flowing sample of water, while the Micromax recorder continuously indicates and records the result without titrating or running of color measurements on grab samples. As a result, acidic corrosion of still, tubes and other parts is said to be greatly reduced; tube and still life, greatly lengthened.

This equipment is described in a new eight-page bulletin, just issued by the Leeds & Northrup Co., 4934 Stenton Avenue, Philadelphia, Pa., Bulletin N-96R-702(A), "Dehydrator-Water pH Recorded by Micromax."

Downingtown Iron Enters Heat Transfer Field

Downingtown Iron Works, Downington, Pa., known for many years for high quality fabrication of steel and alloy plate into tanks and other eqquipment for the process industries, has recently set up a separate division for the manufacture and design of heaters, coolers and condensers.

This heat transfer division is being housed in its own building and is under the direct supervision of men having long practical and technical experience in the design and fabrication of heat exchangers.

Manager of the new division is R. M. Armstrong, who is in charge of design and sales of the new products. Assisting is F. J. O'Sullivan. Downingtown's consulting metallurgist, Dr. T. H. Nelson will collaborate on problems involving unusual metallurgical problems.

Products of the new division will include: steel and alloy heat exchangers for various process heat transfer applications, including heaters, coolers, condensers, etc.

Anchor-Type Elastic Stop Nuts Now Available

Following the successful use of their anchor-type nuts in aircraft construction, Elastic Stop Nut Corp., 2332 Vauxhall Road, Union, N. J., now offers these nuts for blind-mounting applications on general industrial equipment. Designed to provide vibrationproof fastenings for removable plates used to cover hand holes, access and inspection openings, and for other blind-mount attachments, anchor nuts are permanently riveted to the inside of the structure.

The bolts, which are inserted from the outside, pass first through the removable plate, thence through the structure into the stationary nuts. These nuts are offered in a wide range of size, material, and thread system.

A further explanation of the Elastic Stop self-locking principle, and a complete listing of the anchor nuts, are contained in a fully illustrated catalog which will be sent upon request to the manufacturer.

Primoid Standard Is One of Four New Waterproof Compounds

Primoid Standard, a product of Primoid Products Corp., 103 Park Avenue, New York, is one of four new waterproofing compounds which are effective seals for concrete, brick, stone and other types of masonry, as well as for wood and composition materials such as shingles. These Primoid products can be used to prevent or correct any leakage problem from mere moisture to a flowing stream.

Primoid Standard will not crack or peel off, and is not affected by heat or cold. It can also be used as a coating for iron, steel and other metals, and will prevent corrosion, because it is resistant to oils, alcohol, gasoline, brine, acids, and other chemicals.

Buckeye Announces New Controls For Model HD Hoist

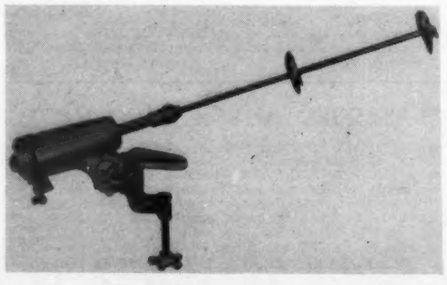
The Buckeye Traction Ditcher Co., Findlay, Ohio, announces an improvement in the design of the control levers and linkage on Buckeye Model HD (heavy duty) power-control units for Allis-Chalmers, Cletrac, and Caterpillar tractors. The change incorporates relocated horizontal control levers which are placed within easier reach of the operator.

Better leverage is now secured and operation is simpler and more positive. The fair lead swivel sheaves have been lowered, thus bringing the direct line pull closer to the tractor drawbar, resulting in better tractor balance. Complete control lever and linkage assemblies are interchangeable with the older style mechanisms and are available for replacing them.

Air-Driven Mixers Offered By Mixing Equipment Co.

The Mixing Equipment Co., Rochester, N. Y., has just announced the addition of two new models to their line of mixers. These two propeller type mixers, the AR-25 and AR-33, incorporate air-driven motors and represent the first units with this type of propulsion offered by the company.

The turbine-type air motor used in these two mixers is especially designed for agitator duty with built-in muffler for quiet operation and features a low rate of air consumption. The mixers are built for operation at air pressures of from 60 to 120 pounds with the optimum operating range between 70 and 90 pounds.



Other features of these air-driven models include a quick removable shaft for ease in cleaning—adjustable shaft length for various sizes of containers—and sturdy construction with extra ball-bearing removing whiploaded from the motor bearing. A universal clamp permits mixer to be used at any angle in tank. This provides complete control over the mixing action including: intentional vortexing, mild swirl, or rapid bottom-to-top turn-over.

A patent has been applied for on the hand-tightening device while one has been issued on the ball and socket clamp. The mixers will attach to any container or vessel. A complete line of accessories, various types of impellers, support brackets, etc., are available for special applications, while a full range of metals and alloys for shafts and propellers permits use in any liquid.

Officials of the Mixing Equipment Co. stress the fact that air-driven mixers are not designed to supplant power-driven models. In certain applications, though, they do possess definite advantages. An air motor is totally enclosed and nonsparking, thus eliminating hazards from this source. Neither can it be burned out by overloading.

The "LIGHTNIN" AR-25 operates at 1750 r.p.m. A 36-in. shaft with 3-in. propeller is standard. Weight is 26 lb. The AR-33 has the lower operating speed of 400 r.p.m. and comes equipped with a standard 36-in. shaft. Propeller size is 7 in. Weight of the complete mixer is 29 lb.

AMONG EQUIPMENT MEN

American Meter Appoints Manager for Midwest

The board of directors of American Meter Co. has advanced C. B. Dushane, Jr., to the managership of the Midwest territory. This promotion came in recognition of Hr. Dushane's 21 years in American Meter Co. service. In 1920 he left the Naval Aviation service, where as pilot he had flown abroad in 1917-19, and became associated with the Maryland Meter Works division of the company. Subsequently he was transferred to the Chicago office. He successively occupied the positions of representative, engineer, and assistant manager.

As an active participant in gas association work, Mr. Dushane holds membership in the American Gas Association, the Illinois, Indiana, Michigan, and Wisconsin state associations. He also is past president of the Midwest Gas Association, and permanent member of its executive council.

Paul Jones Elected Head Of S. M. Jones Co.

At a recent meeting of the board of directors of the S. M. Jones Co., Toledo, Ohio, Paul H. Jones was elected president to succeed his brother Percy C. Jones who passed away October 9, 1941, at Beaumont, Texas. Mason B. Jones was elected vice president and secretary.

BUSINESS NOTES

The appointment of Earl C. Maund in a sales and engineering capacity at their Chicago office, has been announced by Manning, Maxwell & Moore, Inc., of Bridgeport, Conn. Mr. Maund's engineering services will cover the products of Consolidated safety valves, Hancock valves, American instruments, and Ashcroft gages. He was formerly an engineer with Sinclair Refining Co.

Following instructions from the U. S. Navy Department, a $2,000,000 expansion project due for completion before May 1, 1942, has been announced by the National Supply Co. On a "letter of intent" from the Navy Department, the steel company will proceed with construction of a larger plant to increase the company's forging press and lathe facilities at Torrance for the production of shafts for large ships and other finished forgings for the Navy and Maritime Commission.

D. K. Hutchcraft and George Probst, of Clark Brothers Co. Tulsa office, and Fred H. Hayes, of the Houston office, are attending the A.P.I. convention at San Francisco. Mr. Hutchcraft returned only a few days ago from a 10-day sojourn in the East, where he attended the American Gas Association convention at Atlantic City, N. J.

Bethlehem Supply Co. is erecting a new store building at Harvey, La. The personnel will be composed of T. H. Salter, district manager; Roy Maness, store manager and field salesman; and E. C. Dorroh, assistant store manager. The store will be open for business shortly after November 1.

CLASSIFIED ADVERTISING

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Leases and Drilling Blocks

LEASES—East Texas, La., South Ar 20 acres up, dollar acre up.—Owners—Address Attorney, Box 1122, Little Rock, Ark

LEASES ROYALTIES
PRODUCING OR NONPRODUCING
Texas, New Mexico, Oklahoma, Louisiana and Illinois
20 Years Experience
Inquiries Invited
B. D. BUCKLEY
Paul Brown Bldg., St. Louis, Mo.

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OIL PROPERTIES EXCHANGE
For Sale: Many Producing Oil Properties Royalties, Drilling Blocks, and Oil Investments of various sizes in Mid-Continent area. Contact us to Buy or Sell properties.
Alexander Bldg., Tulsa, Okla.

FOR SALE

One-half interest in desirable producing property in dolomite area of the Panhandle, Hutchinson County, Texas. Well equipped and operated lease with 27 wells on 320 acres, all productive. Present owner in liquidation solicits inquiry from responsible brokers and operators interested in purchase of production on cash basis. Address

BOX A-680
The Oil and Gas Journal
Tulsa, Okla.

OIL DRILLERS ATTENTION: A 2,200 acre oil lease in the FAMOUS LANCE CREEK FORMATION near Lusk, Wyoming, is now available for drilling; the lease is in a proven, producing structure which has been producing oil for more than 20 years. For full details write to W. H. PINE, Faith, S. D.

WILL farm out lease for well; South half, Sec. 34, Township 16, Range 4 East, Dickerson Co., Kansas; Half mile from Lost Springs Production. 1078 — 15th Street, San Bernardino, Calif.

WE OWN THREE BLOCKS OF LONG TERM, LOW RENTAL OIL AND GAS LEASES IN ILLINOIS, EACH BLOCK CONTAINING 3000 ACRES, ALL ARE OFFERED FOR OUTRIGHT SALE AT ATTRACTIVELY LOW PRICES AND ALL MERIT INVESTIGATION. Box A-722, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE Oil and gas leases, small production, Fluorspar and Rock asphalt deposits. Reports and maps furnished on request. W. P. Harley, Bowling Green, Kentucky.

HAVE Oil Company, Inc., would like a partner to operate in Kansas who knows how to promote wells and Broker Leases and Royalties. Box A-733, The Oil and Gas Journal, Tulsa, Okla.

FOR SALE: 80 acre lease, three wells producing 8 bbls. per day. Locations for ten more wells. 600 feet deep, 30 feet of sand. All equipment in good condition. Snap if taken quick. Write H. B. Snyder, Box 126, Ottawa, Kans.

LEASE for Oil or Trapping the SW ¼ of Sec. 15, Tp. 16s, R. 15, Plaquemines Parish, La. Owner, J. Manz. R F D, Goddard, Kan.

Leases and Drilling Blocks

EAST TEXAS Woodbine-Trinity sand wildcats starting. If you have some money and will exercise little common sense and judgment chance you might pick up 10 to 50 for one. E. CROFT, PROCTOR, TEX

HAVE cash buyer for large old shallow leases soon to be abandoned. Send full details and cash price. A-730, The Oil and Gas Journal, Tulsa, Okla.

Ranches—Farm Lands

LOUISIANA Farm for sale. Six adjacent counties producing oil. Recently leased for oil or gas for 5 years. 1026 acres of land. Fields fertile, timber (Hard Woods). Lease and ⅛ mineral rights go to buyer. Bisected by paved state highway. 150 miles NW of New Orleans. Reason for wanting to sell is illness. For inquiries, Address A. V. Boutte, Jr., 2536 S. Galvez St., New Orleans, La.

7000 acre ranch eastern Colo., well watered good grass, $4.50 per acre.
1600 acre ranch, $3.50 per acre, will consider lease for oil.
480 acres nice farm land in best Stevens Co., Kans., gas area, $6000. $1200 will handle.

Write Guy Speakman,
Liberal, Kans.

FOR a hedge against inflation buy a farm in center of Kansas' best oil field. $35 to $100 per acre. Brokers wanted.
AMERICAN INVESTMENT CORP.,
Newman Grove, Nebraska.

WESTERN Ranches—500,000 acres, or smaller. State where wanted. No lists. Howard Ingram, Perrine Bldg., Okla. City.

Legal Blanks

BURKHART'S legal blanks and general forms serving Mid-Cont. oil field since 1908—Okla. Kans. N. Mex. Tex. Ala. Ark. Fla. Ga. Ill. Ind. Ky. La. Mich. Miss. Mo. Neb. N. Dak. Tenn. Wyo. Free catalog samples on request. Burkhart Ptg. & Sta. Co., 115 S. Cinn., Tulsa, Oklahoma.

Incorporation

DELAWARE CHARTERS: Complete service $35. Submitted forms. Chas. G Guyer, Inc., Wilmington, Delaware.

CAPITAL SEEKERS
Put your project before 260 Key-Men. Cost trifling. Details free. AMSTER LEONARD, Fox Theater Building, Detroit, Michigan.

Oil Industry Printing

OIL FIELD LEGAL BLANKS
Leases, assignments, releases, township plat books, well records, etc. Request on your letterhead gets free catalog. Olds Press, 215 East Third St., Tulsa, Okla.

Royalties

ANDREW J. BARRETT
The Philtower
Tulsa. Oklahoma

WE BUY & SELL all types of Oil and Gas Royalties. Sales restricted to registered dealers only. Grimes Royalty Co., Tulsa Loan Bldg., Tulsa, Okla.

WE MAINTAIN A MARKET FOR
REGISTERED DEALERS
IN ALL TYPES OF OIL ROYALTIES

FIRST DEPENDABLE OIL CORP.
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OUR READY MARKETS Enable us to pay cash for producing royalty acreage, lots, units and oil payments. GLOBE SECURITIES CO., LTD., Oklahoma City

DEEDED ROYALTIES
State Oil & Gas Leases
Harry S. Wright, Farmington, N. M.
REGISTERED ROYALTY DEALER

BUY RANCH LAND under oil development. Leased for drilling, returns ⅛ royalty. 20 acres $135 or 40 acres $250. Full details furnished. Write Box A-734, The Oil and Gas Journal, Tulsa, Okla.

Help Wanted

WANTED
ASPHALT TECHNOLOGIST
Position requires man with technical degree and who has had experience in the manufacture and blending of roofing and paving asphalts. Location, middle West with medium sized oil company. Our employes know of this advertisement. Box A-711, The Oil and Gas Journal, Tulsa, Okla.

WANTED
Refinery Engineer for design and construction work. Medium sized growing plant in middle west. Box A-721, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER WANTED in central states refinery. Must be a college graduate in engineering and experienced in design and erection of petroleum refining constructions. A-731, The Oil and Gas Journal, Tulsa, Okla.

Situations Wanted

EXPERIENCED Mechanical Designer, B.S. degree, 24 years old, draft free, now employed major chemical company, wants manufacturing or refinery work. 802 W. 41 St., Houston, Tex.

Financing

LOANS made on producing oil, gas and mineral lands. New York Note & Share Corp., 109 Broad St., New York City.

Mailing Lists

ROYALTY owners, Oil investors, Unit holders, Stockholders, Operating personnel of oil industry. Oil Industry Mailing List Co., Tulsa Loan Bldg., Tulsa, Okla.

Equipment Wanted

WANTED good used 4, 6, 8, 10 and 12 inch pipe, plain or coupled. Write Daniel A. Moritz Co., McKeesport, Pa.

"When a feller needs a friend!"
WANTED and *NEEDED*:
TANK CARS
Also
STORAGE TANKS or SHELLS
Any kind, quantity or location.
Good prices realizable NOW!
Freight Cars, too.
IRON & STEEL PRODUCTS, Inc.
38 years' experience
13412 S. Brainard Ave., Chicago, Ill.
"ANYTHING containing IRON or STEEL"
Ask to be placed on our various mailing lists and request our popular blue WEAREVER Pencil.

HIGHEST cash prices paid for entire plants or individual production tools, milling machines, shapers, drill-presses, lathes, punch presses, electrical equipment and motors. Write us and a representative will call. COOK COUNTY MACHINERY CO., 1132 W. Lake St., Chicago, Ill.

BAILING unit for 3,000 ft. wells. State price and location. Box A-732, The Oil and Gas Journal, Tulsa, Okla.

For Sale—Equipment

FOR SALE
For Immediate Delivery

Two New 26# Natural Gasoline Storage Tanks of 25,000 gallons capacity each, 10′ diameter by 40′ long shell with hemispherical heads, complete with 3′ high support saddles, all necessary connections, tanks built in accordance API-ASME code of new material in Setepmber 1941, have never left fabricating plant and may be inspected before shop painted. Price f.o.b. Shreveport, Louisiana, $3,100.00 each.

BOX A-270

The Oil and Gas Journal,
Tulsa, Oklahoma.

FOR SALE at Oklahoma City: Large quantity 65, 70, 75 and 85 hp. oil field boilers, repaired and unrepaired. Cities Service Oil Co., Bartlesville, Okla.

10½ MILES
4½" welded main line pipe, one-half of it Barrett's hot enamel coated.
5½ miles same size, gathering system, all coated.
Valves and fittings.
2—5000 Barrel bolted tanks, pipe and tanks installed new, two years ago.

RECO PIPE LINE CO.
Nixon Building
Corpus Christi, Tex.

FOR SALE: Two sets (8 each) cast heads for 8 cylinder, Superior diesel electric engine. Galoob Iron & Metal Co., Healdton, Okla.

FOR SALE—5½ Keystone self-propelling drilling machine complete with tools. Excellent condition. Chas. Stoskopf, 138 Ida St., Allegan, Mich.

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Classified advertising rates: First insertion, 35 cents a line; each additional insertion, 25 cents a line, PAYABLE IN ADVANCE. Six words usually make a line. Count as a word each one-letter word and each group of figures. White-space computed at regular line rate. Allow two extra lines for blind ads. Ads of less than three lines not accepted. No formal acknowledgment is made, and proofs cannot be shown in advance of publication.

	1 time	2 times	3 times	4 times		1 time	2 times	3 times	4 times
3 Lines	*$1.05*	*$1.80*	*$2.55*	*$3.30*	*7 Lines*	*$2.45*	*$4.20*	*$5.95*	*$7.70*
4 Lines	*1.40*	*2.40*	*3.40*	*4.40*	*8 Lines*	*2.80*	*4.80*	*6.80*	*8.80*
5 Lines	*1.75*	*3.00*	*4.25*	*5.50*	*9 Lines*	*3.15*	*5.40*	*7.65*	*9.90*
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This space may be contracted for over a period of one year from the date of the first insertion and is PAYABLE IN ADVANCE, MONTHLY.

We reserve the right to withhold all advertising of questionable character. To avoid delay be sure to send remittance with copy. We will set your ad in the smallest amount of space possible and refund all overpayments. One-time insertions will not be run until fully paid. Forms close MONDAY NOON before each issue date.

THE OIL AND GAS JOURNAL

Tulsa, Oklahoma